

CONTRIBUTIONS TO THE
HISTORY OF NORTH
AMERICAN ORNITHOLOGY

VOLUME III

Edited by
WILLIAM E. DAVIS, JR.
and
JEROME A. JACKSON

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**CONTRIBUTIONS TO THE
HISTORY OF NORTH
AMERICAN ORNITHOLOGY**

VOLUME III

MEMOIRS OF THE NUTTALL ORNITHOLOGICAL CLUB,
NO. 17

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Preface

This book is the third in a series that had its genesis in a symposium on the history of North American ornithology at the 1991 annual meeting of the Association of Field Ornithologists at Ohio Wesleyan University. The first volume, published in 1995, is an eclectic assortment of contributed chapters, with contributions to ornithology ranging from museums, universities, and government agencies, to historical essays on biogeography, Alexander Wilson, Canadian ornithology, and a chapter on the literature of the history of North American ornithology. There were major “holes” in our coverage that we attempted to fill with a second volume, published in 2000. In volume II we presented chapters on the history of ornithology at a number of institutions, included chapters on two professional organizations, and a chapter of personal recollections. This third volume continues the emphasis on institutional histories but includes chapters on eclectic subjects such as a biography and a group of early bird banders.

We have placed the organization and institutional chapters at the beginning of the book, approximately in the order in which they were founded. Then follow the chapters on more general subjects.

As in the first two volumes, most chapters are “court histories,” written by people who participated in making the history they write about. We continue to believe that despite the potential for bias, these “insiders” historical accounts are important because of the insights provided through personal experience and intimate knowledge of the subject matter. These histories provide much information necessary for future historical synthesis. We hope that the essays of this volume will have heuristic value as well as providing interesting reading.

We thank the authors for their patience and good will during the editing phase and our constant harassment about deadlines.

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Massachusetts Audubon Society: the First Sixty Years

*Richard K. Walton*¹
and
*William E. Davis, Jr.*²

ABSTRACT.—The Massachusetts Audubon Society (MAS) was established in 1896, becoming the first state Audubon society and a model for scores of state and local Audubon societies established in the first half of the twentieth century. Initially focused on eliminating use of feathers of wild birds in the millinery trade, its vision rapidly expanded to encompass a broad spectrum of educational and conservation initiatives. MAS printed educational leaflets, bird calendars, and beginning in 1917, a *Bulletin of the Massachusetts Audubon Society* that was issued nine times a year. A junior membership category, together with classes, programs, and summer camps, emphasized educational objectives that have been the hallmark of MAS since its inception. The first president of MAS, William Brewster, was a leader in conservation matters nationally, especially in the formation of the American Ornithologists' Union. He thus was able to link MAS with national concerns including passage of national and international bird protection legislation. Brewster typified the strong leadership that MAS had in its formative years. Another early president, Edward Howe Forbush, was the first state ornithologist for Massachusetts. Habitat preservation became a major concern of MAS; with acquisition in 1916 of Moose Hill, in Sharon, MAS began a sanctuary system that developed into a statewide network of bird sanctuaries and centers for local education programs. MAS played an important role locally and nationally in the development of sport "birding," an effort that continues to generate support for conservation nationally. Unlike many local and state Audubon societies, which became branches of the National Audubon Society, the Massachusetts Audubon Society has remained independent throughout its existence.

On a January afternoon in 1896, Harriet L. Hemenway of Clarendon Street, Boston, went to have high tea with her cousin Minna B. Hall.

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Hemenway carried with her a copy of *The Boston Blue Book*, Boston's social register. Together, these two proper Bostonians went through the register in search of the names of "the ladies of fashion who would be likely to wear aigrettes on their hats or in their hair" (Graham 1990:15; cf Hemenway and Hall undated). This informal meeting marked the beginning of the Massachusetts Audubon Society (originally, Massachusetts Audubon Society for the Protection of Birds). Within a decade, MAS would have a well-defined education program and a membership in excess of 6000 (Kimball 1906). During this same era, MAS played an important role as a model for similar organizations in other states and at the national level. That the MAS prospered was a sign of the times. There had been earlier voices urging bird preservation, but these were often lone voices unable to generate and/or sustain a broad base of support. While the aim of Harriet Hemenway and Minna Hall was to eliminate the fashionable use of certain bird plumes, MAS goals soon broadened. During its first 25 years, the Massachusetts Audubon Society would play a pioneering role as it gave voice to a growing social conscience concerned with the protection and conservation of the state's natural resources (Packard 1921). A clearer picture of the conditions that led to the successful beginnings of the MAS may be achieved by a brief look at various late nineteenth century natural resource practices that preceded the Society's inception.

Late nineteenth century Massachusetts.—By the final decades of the nineteenth century, Massachusetts bore the scars of more than 250 years of "higher" civilization. The colonial era, as well as post-revolutionary war expansion, had resulted in profound changes in the state's landscape. Woodlands had been reduced to a mere remnant of the pre-colonial forest; intensive farming practices had stripped the soil of nutrients, and the state's wetlands, rivers, and harbors were rapidly being despoiled by manufacturing ventures. Populations of large predators and many fur-bearing mammals were nearly extirpated. During colonial times, birds were shot and trapped for a variety of reasons. Hawks, owls, blackbirds, crows, and jays often had a bounty on them. These perceived pests of barnyard and field were favorite targets of the farmer. Other species, including Wild Turkey (*Meleagris gallopavo*), Passenger Pigeon (*Ectopistes migratorius*), and various waterfowl, were hunted for the table. Birds such as cranes and herons were frequently shot because they were attractive targets. The economics and technology of

shot, powder, and muzzle-loaded firearms probably limited the number of species threatened during the colonial period. However, populations of some bird species were severely reduced and a few extirpated during the first two centuries of European settlement.

As damaging as early habitat destruction and hunting were to Massachusetts bird populations, the nineteenth century assault directly affected a much larger portion of the state's birds. During the 1800s, market hunters developed profitable means for slaughtering massive numbers of shorebirds and waterfowl. Cheaper and better weapons made bird hunting a possibility to a broad spectrum of people. An increasing tide of immigrants swelled the ranks of the hunters. Towards the end of the century, Victorian fashion championed the lavish display of stuffed birds in the parlor and bird plumes on bonnets and bustles. While pressures on bird life had earlier been more or less restricted to the larger game birds and hawks, the late nineteenth century brought an unprecedented attack on a wide range of species including songbirds.

In the midst of this depredation, small groups of ornithologists, sportsmen, and writers began to decry the destruction of bird life. Although their motives for bird protection were often different, the efforts of the early bird conservers marked the beginnings of a movement that resulted in effective education and legislation early in the twentieth century. Initial organized efforts promoting bird protection came from the scientific community. In 1883, a small group of ornithologists proposed the formation of a national organization. One of the founders of the American Ornithologists' Union (AOU), William Brewster, was among these ornithologists.

Pearson (1933:200) gave Brewster credit for starting, "the first organized work for emphasizing protection of non-game birds." At the second annual meeting of the AOU held in New York in October 1884, bird protection became an active concern. The minutes of the meeting include the following:

"Mr. Brewster called attention to the wholesale slaughter of birds, particularly of Terns, along our coast for millinery purposes, giving some startling statistics of this destruction, and moved the appointment of a Committee for the Protection of North American birds and their eggs against wanton and indiscriminate destruction, the committee to consist of six, with power to increase its number, and to coöperate with other existing protec-

tive associations having similar objects in view. After earnest support of the motion by Messrs. Brewster, Chamberlain, Coues, Goss, Merriam, and Sennett, it was unanimously adopted, and the following gentlemen were named as constituting the Committee: William Brewster, H. A. Purdie, George B. Grinnell, Eugene P. Bicknell, William Dutcher, and Frederic A. Ober.” (Anonymous 1884:376).

Although Brewster remained on the committee for many years, a new chairman, George B. Sennett, was elected in 1885. In 1886, the AOU Committee produced a pioneering document in bird conservation. *Bulletin no. 1* of the AOU Committee on Bird Protection contained a number of important papers including one by Joel Asaph Allen (first published in *Science*, 1886) titled, “The present wholesale destruction of bird-life in the United States.” Other contributions to the *Bulletin* indicate a growing concern among ornithologists. Included with this publication was what came to be known as the “AOU Model Law.” This legislative model defined the difference between game and non-game species, suggested legal protection for all non-game birds, and recommended a prohibition of the destruction of bird eggs. The ornithologists carefully included language to protect their own rights to collect birds for scientific purposes. By the end of its first decade, the Committee on Bird Protection had proposed much but accomplished little. William Dutcher, a member of the committee, gave the following assessment of their early efforts, “At the close of the year 1895, the low tide of bird protection had come and the end of the first cycle was at hand. The AOU Protection Committee was discouraged and hopeless, feather wearing was as rampant as ever . . .” (Dutcher 1905:55).

This initial lack of success on the part of professional ornithologists was perhaps best explained by one of their own. J. A. Allen, writing seven years before the formation of the AOU, stated: “In too many cases [bird protection laws] fail of their objective from the want of an intelligent public opinion to ensure their enforcement” (Allen 1876:943). Allen went on to suggest a solution, “Societies should be formed whose express object should be the protection throughout the country of not only of these practically innocent and pleasure-giving species, but also the totally innoxious herons, terns and gulls, whose extirpation is progressing with needless and fearful rapidity” (Allen

1876:944). However, before such societies could attract a membership, the public needed to be motivated and educated.

During the latter decades of the nineteenth century, this critical educational process was begun through the increasingly popular genre of natural history literature. The writings of John Burroughs (Renehan 1992) and John Muir (Miller 1993) awakened the American public to a national treasure. Muir's inspirational descriptions told of the grandeur and majesty of the western ranges and forests, while Burroughs taught his fellow Easterners about the natural wonders of their local meadows, fields, and forests. Although Muir and Burroughs were dominant figures, other writers such as Sidney Lanier, Clarence King, Wilson Flagg, and Thomas Starr King added important contributions. Woman authors such as Olive Thorne Miller, Mabel Osgood Wright, and Florence Merriam Bailey contributed to an ever-growing interest in nature study among both adults and children (Welker 1955, Barrow 1998). Wright's *Citizen Bird* (Wright and Coues 1898) and Bailey's *Birds Through an Opera Glass* (Merriam 1889) brought the pleasures of bird study to the public. Because much of the best natural history writing of this era appeared in newspapers and magazines, the authors attracted a wide public following—a far cry from the audience likely to come across an AOU publication.

There were strong ties between the popular press and the ornithological community. Many amateur and professional ornithologists worked for, or contributed to, lay publications. George Bird Grinnell, an original member of the AOU Committee on Bird Protection, was the natural history editor for *Forest and Stream* magazine. It was Grinnell who organized the first Audubon Society (Barrow 1998). His interest in birds was not incidental. Born in Brooklyn, New York, in 1849, Grinnell soon moved to Audubon Park where he would live most of his life. There, in one of the houses on the estate of the late John James Audubon, Grinnell grew up surrounded by the great ornithologist's trophies, guns, bird collections, and paintings. Grinnell was tutored by Audubon's widow, Lucy, and shared in the continuing work of the naturalist's son, John W. Audubon. Grinnell left Audubon Park to study at Yale where he eventually became an assistant to O. C. Marsh. In 1876, he went to work for *Forest and Stream*. His idea for an Audubon Society was presented in an editorial on 11 February 1886. The organization was to be, in Grinnell's words:

“... an association for the protection of wild birds and their eggs, which shall be called the Audubon Society. Its membership to be free to every one who is willing to lend a helping hand in forwarding the objects for which it is formed. These objects shall be to prevent, so far as possible, (1) the killing of any wild birds not used for food; (2) the destruction of nests or eggs of any wild bird, and (3) the wearing of feathers as ornaments or trimming for dress” (Grinnell 1886:41).

The specifics of this editorial are essentially the AOU message presented in a public forum. The Society's success was meteoric. Within three years it claimed 40,000 members and in February of 1887, the Forest and Stream Publishing Company had established the *Audubon Magazine* to reach a growing audience. Numerous testimonials in support of the movement came from such men as Henry Ward Beecher, John Burroughs, and Oliver Wendell Holmes. Membership in the Audubon Society was free; one simply signed the Audubon pledge. Secretaries worked to establish and maintain local societies. In November of 1886, the AOU went directly to the Audubon Society audience by publishing its second *Bulletin* within the pages of *Forest and Stream* ([Allen] 1886). Unfortunately, the movement's rapid growth was matched by an equally rapid decline. By the end of 1888 the economic burdens of publication and weak organizational structure resulted in the initial Audubon Society's early demise. The success, albeit brief, of Grinnell's creation clearly demonstrated that a receptive audience existed.

During the final quarter of the nineteenth century, two separate but related forces were gaining strength. While market gunners, milliners, and “pot-hunters” were exacting an ever-increasing toll on the bird life, and some states offered bounties for carcasses of hawks and owls, a growing base of support for bird preservation was developing among an educated public. A new conservation movement was being influenced by a core of writers and professional ornithologists. Although men and women such as Burroughs, Grinnell, Wright, and Bailey led the way, there were other less famous persons destined to develop the grassroots support that was critical to any effective bird protection movement. That one of the earliest and most effective components of this movement should have its start in a Boston drawing room is perhaps not surprising. The scions of Boston society represented both sides of the struggle.

While many of these genteel ladies were perfectly happy, indeed proud, to wear the bird-adorned fashions of the day, others were honestly dismayed and concerned over these practices. It was to be the educated and affluent women of this latter group who would initiate important changes.

THE FOUNDERS

Harriet Lawrence was born in Boston in 1858. In 1881, she married Augustus Hemenway (Crawford 1930). Both the Lawrence family and the Hemenway family were educated, wealthy, and dedicated to public service. Early in the century, Harriet Lawrence Hemenway's paternal grandfather had established one of the most important mercantile houses in Massachusetts. Cotton mills in Lowell and Lawrence formed the foundation of this enterprise. Harriet's father, Amos Lawrence, went to Harvard and then into the family business. Amos Lawrence supported the "free-soilers," an antislavery effort in Kansas, and was a candidate for governor of Massachusetts. Lawrence also served as treasurer and an overseer of Harvard College. His charitable work was extensive; two projects which resulted from Lawrence's organization efforts and financial support were Lawrence Hall at the Episcopal Theological Seminary, and Memorial Hall at Harvard.

The Hemenway family had much in common with the Lawrences. Augustus' father had been instrumental in opening up South American trade earlier in the century. This resulted in Hemenway ownership of silver and nitrate mines in Valparaiso, Chile, and ultimately, in great family wealth. Augustus Hemenway graduated from Harvard in 1875 and spent much of his time managing family wealth. He was active in charitable endeavors and gave funds for the Hemenway Gymnasium at Harvard and a town library in Canton. Hemenway served in the Massachusetts legislature, worked to establish a metropolitan park service and was a trustee of the Boston Museum of Fine Arts and of the Groton School.

The Lawrence family and the Hemenway family were in the mainstream of nineteenth-century Boston aristocracy. They enjoyed the privileges of wealth and the obligations of noblesse oblige. Soon after they were married, Harriet and Augustus purchased a 405-ha (1000-acre) working farm in Canton. The couple shared a love of nature and their

farm provided an ideal place to ride, hike, and look for birds. Whether at their Longwood residence, the Canton farm, or properties in New Hampshire and Cape Cod, the Hemenways kept their binoculars and bird books nearby.

In 1896, when Harriet Hemenway sat down with cousin Minna Hall to review the Boston Register for potential plume wearers, she was acting in the best traditions of her family. Harriet Hemenway had both motivation and means for combating the fashionable use of bird plumes. Although there are no written records of the original meeting between Hemenway and Hall, many years later these two ladies recalled the specifics of their tea-time chat. "We had heard that Snowy Egrets [*Egretta thula*] in the Florida Everglades were being exterminated by plume hunters who shot the old birds, leaving the young to starve on the nests. These plumes brought a high price in the market" (Hemenway and Hall undated). Hemenway and Hall decided to form a society for the protection of birds. They directed their initial appeal to those very "ladies of fashion" who were supporting the millinery trade in bird feathers (Orr 1992). Their first project was to be a circular informing potential members of the depredations of the plume hunters and asking for pledges to fight these practices.

Harriet Hemenway and Minna Hall realized that the effectiveness of their effort would be greatly increased if they could gather together a group of people with a variety of skills and resources to direct the society. On 10 February 1896, such a group met at the Hemenway residence on Clarendon Street. The minutes of this meeting constitute the first written record of the Massachusetts Audubon Society:

"An informal meeting of the directors of the Massachusetts Audubon Society was held with Mrs. Hemenway, 273 Clarendon Street, Boston. Monday, February 10th at 4 o'clock. There were present Mrs. [Arthur T.] Cabot, Mrs. [Frank] Bolles, Miss [Minna] Hall, Mr. [Outram] Bangs, Mr. [James Arnold] Lowell, Mr. [Charles S.] Minot, Mrs. [Harriet] Hemenway, Miss [Harriet] Richards, the Secretary Dr. Richards in the chair." (Anonymous 1921).

At this meeting, the board discussed the wording for their circular and appointed committees on publication, information, and bylaws. The meeting was chaired by Charles Sedgwick Minot. Charles Minot played an important role during the formative years of the MAS. His accom-

plishments and honors were many. He had studied at M.I.T. and Harvard, done research with Louis Agassiz, taught at the Harvard School of Medicine, and was a member of the National Academy of Sciences and president of the American Society of Naturalists (Malone 1934). Minot served as chairman of the board for MAS from 1896 until 1901.

William Brewster (1851-1919)—president 1896-1913.—The second meeting of the Massachusetts Audubon Society, held on 19 February 1896, was attended by the original group and William Brewster (Figure 1). Brewster served as president of MAS during its first 17 years. The board of directors could not have made a better



Phototyp. Photo William Brewster *107. Massachusetts Zool. Museum*

Figure 1. William Brewster, 29 September 1883. Photograph courtesy of the Ernst Mayr Library, Museum of Comparative Zoology, Harvard University.

choice. Francis H. Allen gave the following appraisal of Brewster's qualifications, "The Directors of the new society were very fortunate in getting William Brewster to serve as their president. He was universally recognized as the leading ornithologist of New England, and he was a man of great natural dignity, always commanding respect and admiration" (Allen undated:3). Besides professional expertise and dignified leadership, Brewster brought to MAS a breadth of perspective that included the legitimate concerns of sportsmen and ornithologists.

William Brewster grew up in Cambridge, Massachusetts, at that time a rural area of farms, meadows, streams, and ponds. He and a group of like-minded friends spent most of their waking hours exploring the local fields and creeks, all the while adding to their bird collections. Not just "pot-hunters," Brewster and his friends were gaining the experiences that would form the basis for a lifetime of ornithological studies. In November 1873, Brewster and several of his birding companions formed the Nuttall Ornithological Club (NOC) (Batchelder 1937, Davis 1987). The meetings and publications of the Nuttall Club gave focus to local bird studies, and its membership provided the country with a steady stream of knowledgeable ornithologists. Many of these same NOC members later served on the board of the MAS. Brewster had been instrumental in establishing the AOU and, through the work of that organization, pioneering bird conservation in America. Meanwhile, he had also intensified his studies of Massachusetts birds. By 1890 he had purchased the 121-ha (300-acre) October Farm in Concord and was involved in extensive field work in the Sudbury River Valley (Walton 1984). In 1896, when the Massachusetts Audubon Society board was looking for a man to fill the presidency, they found in William Brewster the most knowledgeable ornithologist in the state as well as one with national ties and experience in bird protection.

Harriet E. Richards—secretary-treasurer (1896-1903).—A major portion of the early work of the MAS was educational and promotional. Membership roles needed to be built and information disseminated. The board, through its committees, established policies and programs that were channeled to various groups including members, school children, politicians, and business groups. Most tasks required a tremendous amount of paper work. Responsibility for the bulk of this fell on the shoulders of Harriet Richards. Richards served as secretary-treasurer of MAS through 1903. This was an era of handwritten correspon-

dence and individually addressed envelopes. Although circulars and informational leaflets were printed, the process of distribution was time consuming. Richards was also responsible for establishing and maintaining communication with local Audubon secretaries in over 100 Massachusetts towns. While many of the early board meetings were held at the Hemenway or Cabot residences, the Society arranged for office space by the end of 1896. Harriet Richards carried on most of the work of MAS from a desk in the library of the Boston Museum of Natural History (the old Bonwit Teller Building) at 234 Berkeley Street. In addition to her secretarial duties, Richards wrote articles for MAS publications, and gave lectures and other programs (Packard 1921).

George H. Mackay.—At the second meeting of the MAS, George Mackay was invited to join the board of directors. Mackay was one of the most knowledgeable sportsmen-ornithologists of his era. He was particularly interested in the birds of coastal Massachusetts including waterfowl, shorebirds, gulls, and terns. Mackay's concerns about over-hunting, egg stealing, and the plume trade led him to lobby for protective legislation and to establish practical conservation programs. During the latter part of the nineteenth century, activities of plume hunters in Massachusetts were particularly devastating to tern populations. Mackay organized wardens at important nesting areas, such as Muskegat and Penikese, to protect bird colonies and monitor nesting success. When Mackay joined MAS in 1896, he brought a wealth of experience regarding conservation programs that the Society would eventually adopt. For many years, Mackay also served as the Society's eyes and ears in the Massachusetts legislature (Palmer 1943).

Minna B. Hall.—In addition to her efforts as a co-founder of MAS, Minna Hall served on the board of directors for more than 50 years. Minutes of early meetings regularly record her presence. Hall devoted much energy to the publications, calendar, and traveling library committees. She also served as a delegate to national Audubon Society annual meetings. Several times, it was Minna Hall's quiet leadership that moved MAS through difficult times. In March 1913, William Brewster expressed to the board his inclination to resign over differences of opinion regarding game-bird legislation. It was Minna Hall who asked Brewster to reconsider:

"I think I understand your position," Hall wrote (to Brewster, 17 March 1913; Special Collections, Ernst Mayr Library, Museum of Comparative Zoology, Harvard University [MCZ]), "and why you want to resign, but is it not possible for you to express your opinion freely, as an individual, without being hampered by your position in the Audubon Society? It seems important for us as a Society, to hear every point of view, and I feel sure, if you leave us, we shall become narrow minded and unscientific."

Brewster did reconsider and stayed on as president.

Harriet L. Hemenway.—If anything, Harriet Hemenway presented an even lower profile than her co-founder Hall. Hemenway originally declined a directorship and was content to be included on the list of vice presidents. For the most part, the position of vice president was an honorary one and included persons whose names would lend prestige to the Society. The list of early vice presidents includes such names as Agassiz, Gardner, Hunnewell, Peabody, Scudder, and Torrey. Harriet Hemenway did committee work from time to time but more importantly, she generously provided funding for a variety of projects. In the early years of the MAS, cash reserves were often perilously low, but Harriet was always there with \$500 for the Audubon calendar, \$500 for general expenses, \$100 for printing a bird chart, or a loan of \$2000. Her financial support allowed the board to carry out many of the initial projects that built the Society's reputation. In 1910, Hemenway was elected to the board of directors. She served in that position until 1926.

EARLY GOALS AND ACHIEVEMENTS

The founders of the Massachusetts Audubon Society had two goals in mind. They wanted to (1) halt the fashionable use of bird plumes, and (2) further the cause of bird protection. Both objectives were clearly stated in the opening sentence of the first leaflet, a prospectus for the MAS, published for distribution. The following from that prospectus was later published in *The Auk* (Dutcher 1897:31):

“The purpose of the Society is to discourage buying and wearing for ornamental purposes the feathers of any wild bird, and to otherwise further the protection of our native birds.”

The founders had chosen a specific project, the elimination of the millinery trade in aigrettes, with high public visibility and support from the professional ornithological community. At the same time, the Society’s broader goal of bird protection had the potential to appeal to a wide range of citizens as a lifelong educational interest.

In one sense, the aigrette question was a moral issue. The original prospectus contains such phrases as “the evil we would restrain” and “reckless demands of fashion” (document missing). [Note: Since the first draft of this manuscript was written, the historical records of the Massachusetts Audubon Society have been moved twice. In the first move, many documents were moved from the headquarters building at Drumlin Farm, Lincoln, to the Massachusetts Audubon Society’s Visual Arts Center in Canton. Subsequently, these historical materials and remaining historical materials from a variety of locations were transferred to the Massachusetts Historical Society, where they are being sorted and catalogued. Many documents are currently missing. In this chapter quotes from documents that can no longer be located are referenced as “document missing.”]

Certainly this would appeal to proper Bostonians. But the founders also stressed issues that today we would define as ecological in nature. The millinery trade in herons and egrets was, they said, significantly reducing the populations of certain species. The specific problems of plumage use were placed in a broader context. Although we can appreciate Francis H. Allen’s characterization of this era as being one of “clear-cut issues, when black was black and white was white” (Allen undated:2), the minutes of the early board meetings indicate that they too struggled with defining issues. At their first formal meetings in 1896, Dr. Minot led lengthy discussions regarding purposes and bylaws. One significant decision was to exclude the clause “except ducks and game-birds” from their statement of purpose. Despite sentiment to narrow their purpose, no doubt expressed by certain board members themselves, MAS resisted the temptation to cater to any specific group, in this case the sportsman/hunter.

Leaflets titled, *Ostrich Feathers*, *To the Members*, and *To Save Our Birds* followed the publication of the prospectus and contained explana-

tion of the prohibition of plume use as well as providing information on membership in the Society. Other early leaflets such as *Helps to Bird Study* and *The Baltimore Oriole* supplied educational materials to the would-be birder (Records of the Massachusetts Audubon Society, Massachusetts Historical Society (MHS)). Besides their own publications, the MAS made use of sympathetic literature from other sources.

Local secretaries.—One of the earliest and most effective organizational moves by the board was the recruitment of local secretaries. These were Massachusetts Audubon Society volunteers in various cities and towns whose jobs were to distribute information, seek new members, and monitor educational efforts. The local secretaries gave special attention, through their visits to churches and schools, to signing up junior members.

In the “First Report of the Massachusetts Audubon Society,” distributed in October 1897 a listing of over 100 towns is given with the names of the local secretaries. This statewide coverage established a grassroots basis for the Society. This community-based arm of MAS did much to assure its initial success and continued strength.

Other Audubon organizations.—Another early organizational move was to encourage the formation of other state Audubon societies. Discussion of how to influence conservation efforts in other states was begun at the third general meeting of the directors in April 1896. While it was decided to leave the initiation of such societies in the hands of the individual states, the board decided to use every effort to promote establishment of societies in other states. Regular communication was maintained among the early societies and there was considerable sharing of ideas and materials. Leaflets, bird buttons, and legislative models were frequently sent by one society to another. In 1900, the Massachusetts Audubon Society sent William Brewster, Ralph Hoffmann, and Minna Hall to the first conference of state Audubon societies held in Cambridge, Massachusetts (Figure 2). The second annual conference, held in New York in 1901, was largely planned and organized by MAS board members. Minutes of the Massachusetts Audubon Society board meeting for 1902 record a letter announcing the formation of a “National Committee of the Audubon Societies of America” (Records of the MAS, MHS). Ralph Hoffman was elected to represent the Massachusetts Audubon Society in these deliberations. In order to pro-

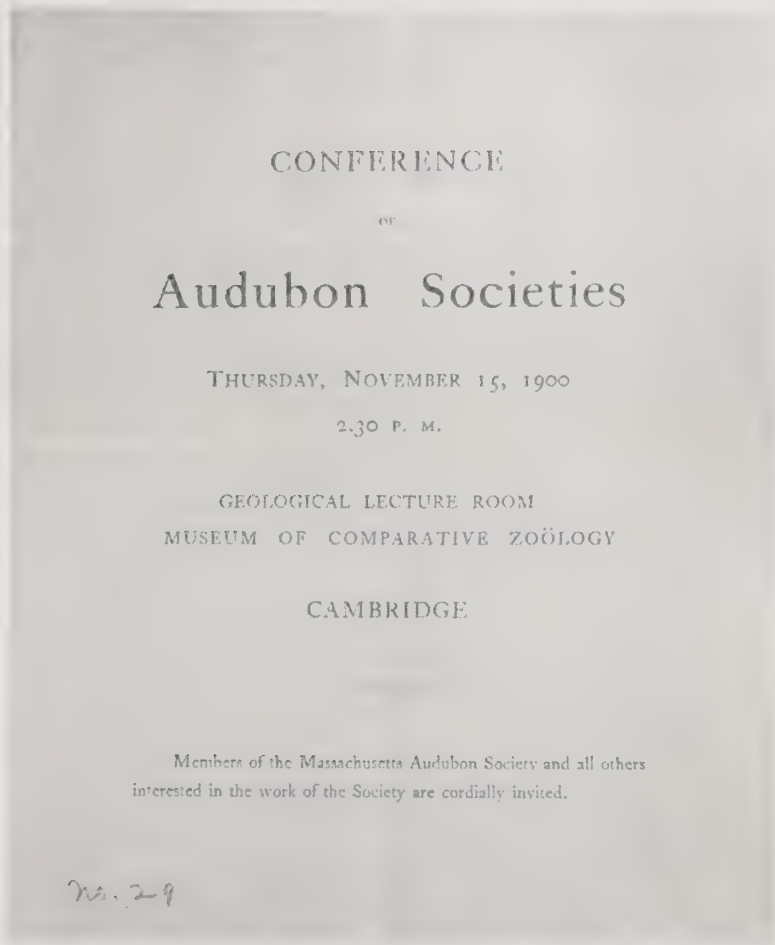


Figure 2. Announcement of the Conference of Audubon Societies, 15 November 1900.

vide a salary for a national secretary, MAS contributed \$300 in 1902 and 1903, thus providing both organizational and financial support for efforts that eventually led to establishment of the National Association of Audubon Societies (NAAS) in 1905 (Graham 1990).

The Massachusetts Audubon Society continued to assist local state societies with organizational models and educational information. By October 1902, MAS could list 27 sister organizations in other states. Although relationships with other state societies were normally amicable and mutually useful, there were, on occasion, a few ruffled feathers. On 12 November 1902, Secretary Richards was instructed to, "write the

Oklahoma Society congratulating them on the organization of a state society and ask explanation of their use of the seal of the Massachusetts Society" (Records of the MAS, MHS).

The Society also had some ties across the Atlantic. Although the Massachusetts Audubon Society was the first state society, the founders credit two English societies (and Grinnell's Audubon Society) as fore-runners in the bird protection movement. The MAS corresponded regularly with the Selbourne Society and the Royal Society for the Protection of Birds. Through these various state, national, and international organizations, the Massachusetts Audubon Society pioneered



Figure 3. Massachusetts Audubon Society 1898 bird calendar.

cooperation towards common goals. A network of mutually beneficial relationships developed that both aided communication and increased results.

Audubon calendar.—Before the first year was out, “The scheme of preparing an Audubon calendar was discussed . . .” The first calendar was published in 1897 (Figure 3). An advertising circular contained the following description:

“The calendar will be illustrated by twelve facsimiles of original watercolor drawings, one for each month, and a descriptive text



Figure 4. Massachusetts Audubon Society 1920 bird calendar.

of the birds. Frank M. Chapman, Olive Thorne Miller, Florence A. Merriam, Abbott Thayer and other ornithologists have contributed original paragraphs. Price - 50 Cents" (document missing).

Over the next 25 years, the Audubon calendar became both a symbol of the Society and a source of income. Mrs. John W. Elliot, joined the board of directors in December 1898 and played a major role in the calendar project. She not only painted most of the watercolor bird portraits for the calendars, but also financed the printing when necessary. Although prints for the 1898-1901 calendars are unsigned, they seem to be Elliot's work. After 1901, Elliot's artistic efforts are acknowledged on the calendars. Originally, the Tabor Prang Art Co. was employed to do the printing. Beginning in 1906, however, the Japanese firm of Matsuki took over the job of printing the bird plates. In at least seven of the first 25 years, calendars were published that contained reissues of previous plates. The Calendar Committee and Elliot constantly struggled with necessary deadlines for production and sales. In 1910, a flood in Japan destroyed the print run and the committee was left empty-handed until December 1911. In 1920 and 1921, in order to save money, the calendar committee used artwork from leaflets purchased from the National Association of Audubon Societies to illustrate their calendar (Figure 4). The art work was done by Bruce Horsfalls and several other artists. Audubon calendars have become a perennial project of the Society and a tradition that continues to the present.

Junior members.—From its inception, the Society made a determined effort to maintain an active junior membership and to involve school children in a variety of educational projects. To become a junior member (under 16), one signed the pledge card that read, "I promise not to harm our birds or their eggs, and to protect them both whenever I am able" (document missing). Initially no dues were required of juniors. A ten-cent fee was later instituted. Local secretaries spent much time recruiting juniors on their visits to classrooms. One of the first programs intended to encourage youngsters was the establishment of Bird Day in the schools. Although attempts to have the legislature give Bird Day a status similar to Arbor Day were unsuccessful, the Society, in 1896, mailed out 1200 "Bird Day" circulars to Massachusetts classrooms. These contained suggestions to teachers on classroom curricula pertain-

ing to birds. Another incentive for youngsters was the Junior Prize Award. The winner of the first such prize was Doris A. Hatfield of Canton for her drawing of a Bobolink (*Dolichonyx oryzivorus*). Perhaps the most successful program to recruit children was a joint venture of the National Association of Audubon Societies and the Massachusetts Audubon Society (Richards 1901a). During 1912-1913, the two societies worked together to send out 22,000 educational leaflets and 5000 announcements to teachers throughout the state. At the end of this period, the board proudly reported, "The number of children enrolled in the State is now 9632 and daily additions are being made to this number" (document missing).

Traveling lectures and libraries.—Two programs created by the Society to "spread the message" were the traveling lectures and traveling libraries. The first lecture, "Invitation to Bird Acquaintance," (1900) was written by Ralph Hoffmann and illustrated with lantern-slides (Richards 1901b). A second lecture, titled "Birds and Home," was prepared by C. F. Hodge. In 1903, Miss A. L. Warner designed a lecture, especially for children, which was illustrated with bird posters. Two additional sets of slides loaned by the Society were, "Birds of Value to Garden, Orchard and Woodland" and "Our Winter Birds." These programs were available free of charge to local chapter secretaries, teachers, and others. In 1901, numerous sets of "Traveling Library No. 1." were offered to public libraries throughout the state. These portable libraries contained Audubon wall charts, Audubon calendars, *Bird-Lore*, and various bird books, including titles by Burroughs, Chapman, Coues, Merriam, and Miller. Four different traveling libraries were eventually assembled and distributed to rural areas by the Woman's Education Association.

Ralph Hoffmann.—Among important figures in the early years of the Society was Ralph Hoffmann, a secondary school teacher and amateur ornithologist (Figure 5). His interest in education and birds resulted in several publications that had a significant influence on birding. Traditional field ornithologists of this era were accustomed to doing most of their birding with a shotgun. Elliott Coues, a leading ornithologist of his day and fellow founder with William Brewster of the AOU, typified the prevailing attitude among professionals. In his *Manual of Field Ornithology* (1874:5), Coues instructed the would-be ornitholo-



Figure 5. Ralph Hoffmann, a stalwart of the Massachusetts Audubon Society from 1897-1910. Photograph courtesy of the Ernst Mayr Library, Museum of Comparative Zoology, Harvard University.

gist on tools of the trade. "The doublebarreled shotgun," he said bluntly, "is your main reliance." Although the necessity for collecting birds was an understandable part of the professionals' effort to describe and classify the avifauna, this approach largely ignored those who might be interested in the birdlife, but were not inclined to shoot every bird they came across. One of the impacts of the ornithologists' perspective was to encourage written descriptions of birds which assumed the observer was holding the freshly killed bird, or a bird skin, in his or her hand. Ralph Hoffmann took a different approach. *A Guide to the Birds of New England and Eastern New York State* (1904) has been called the first true field guide, largely because it describes and highlights bird field

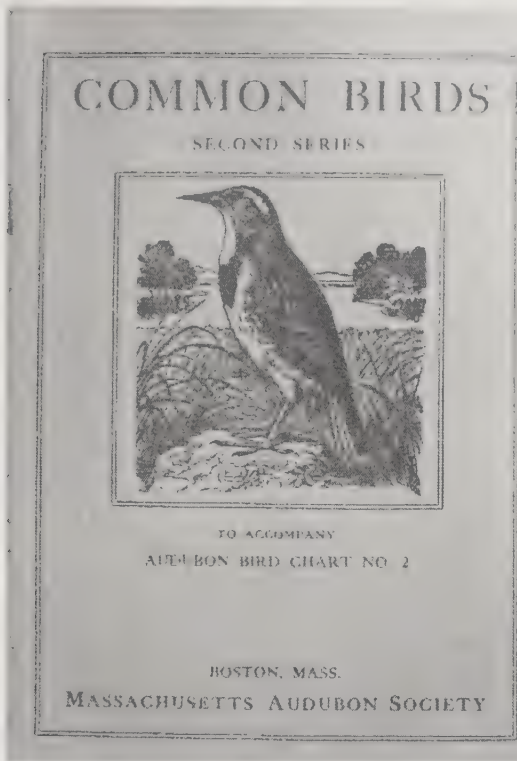


Figure 6. Ralph Hoffmann's booklet that accompanied the Audubon Bird Chart no. 2.

characteristics recognizable with binoculars. Hoffmann's success soon led other authors to write with the field observer in mind. This genre of bird books ultimately led to the ranks of birders far out-numbering professional collectors.

Ralph Hoffmann joined the MAS board of directors in 1897. During his 13 years with the Society, he initiated several popular and successful projects. In 1898, he showed the board a poster-sized bird chart published by the German Society for the Protection of Birds. The directors agreed that it would be advisable to create a similar chart of common New England birds for display in classrooms. Under Hoffmann's direction, the first bird chart was created. Original art work, showing 26 bird species was painted by Edward Knobel. The chart was printed by the Prang Educational Company. Success of the first chart encouraged the board to print "Audubon Bird Chart Number Two" in

1899, again using the talents of Knobel and Prang. Both charts were produced on a cloth backing and were provided with a roller for classroom use. A booklet to accompany each of the charts, with life history information for each of the birds represented, was written by Ralph Hoffmann (Figure 6). The charts proved to be a promotional, educational, and financial success for the Society. Both the charts and Hoffmann's booklets went through several editions, and by 1910, the first two charts had sold over 7000 copies. In 1909, Hoffmann began arrangements for a third chart. The artist he retained was Louis Agassiz Fuertes, perhaps the finest bird painter America has produced. The third chart, "Twenty Winter Birds," painted by Fuertes and printed by the Milton Bradley Company of Springfield, Massachusetts, was published in 1912. A fourth and final chart by Fuertes, "Some Common Migrants," completed the set and was published along with an accompanying pamphlet in 1924 (Figure 7).

Another Hoffmann innovation was the creation of a public lecture series that was presented annually by the Society. Hoffmann gave the first lecture, titled, "Birds and man," in 1899. Other speakers during the early years included Frank Chapman, William Dutcher, T. Gilbert Pearson, and Louis Agassiz Fuertes. Stereopticon slides and later, motion pictures, were used to illustrate the lectures. These talks were instrumental in increasing the Society's rolls and maintaining an active membership (Figure 8). The popularity of the lectures is suggested by the frequency with which ticket sales exceeded 1000. The *Bulletin* for April 1917 describes a gathering of over 3000 people at Tremont Temple, Boston. After a review of the recent legislation by President Forbush, the crowd was treated to Charles Crawford Gorst who "described his adventures in snaring bird songs, illustrating his very able lecture with lantern slides and giving whistling imitations of the songs of the birds" (Anonymous 1917:10).

In 1908, Hoffmann was elected chairman of the board of directors, a position that had remained vacant since the resignation of C. S. Minot in 1901. Hoffmann took on this title as part of his new role as field representative for the Society. He traveled the state giving lectures, conferring with local secretaries, and adding to the Society's membership rolls. As chairman of the board, it also fell to Hoffmann to act as liaison between the board and the president. In the spring of 1909, Hoffmann reported to Brewster that his travels to the western part of the state had resulted in new members and the formation of several local committees.

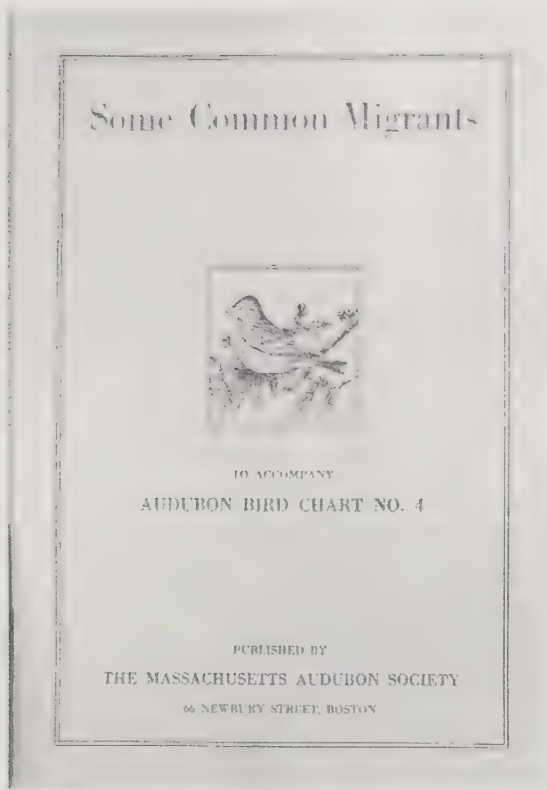


Figure 7. The booklet that accompanied the Audubon Bird Chart, no. 4.



Figure 8. A 1917 ticket to the Massachusetts Audubon Society's bird lecture series.

Later that year, Hoffmann was asked to approach Brewster on a somewhat more delicate matter. Was it true, queried Hoffmann, “. . . that you had within the last few years collected birds, nests or eggs without a license”? (letter Hoffman, to Brewster 2 February 1909; MCZ). The reports, replied Brewster, were untrue. In 1910, Ralph Hoffmann accepted a job at the Country Day School in Kansas City. This ended his active work with the Society although for several years thereafter, he continued to correspond with Brewster and the board on Society matters.

Arthur Cleveland Bent, Charles W. Townsend, and William P. Wharton.—Other early directors brought special talents and experiences to the Society. In 1911, two notable ornithologists, Arthur Cleveland Bent and Charles W. Townsend joined the board. Although Bent, a Taunton resident, was often a member in absentia, he provided knowledgeable counsel and a breadth of perspective. In his letter of acceptance to the board, Bent stated, “. . . that although in sympathy with the principles of the Society, he was not an ultra bird protectionist” (document missing). Charles Townsend served on the board until 1933 and was active in legislative programs. William P. Wharton became a director in 1912 and served as chairman of the board from 1914 until 1920.

Early legislation and the millinery trade.—The Society’s bird protection efforts advanced on several fronts. These included legislative work, educational programs, habitat conservation, and occasionally, direct intervention. At the end of the nineteenth century there were already laws protecting a portion of the state’s bird life. One of the first circulars printed and distributed by the Society contained the “Law of 1886, Chapter 276” and the “Law of 1897, Chapter 524.” Unfortunately, the 1886 bird law was most notable for the species that were excluded from its purview. It did not apply to upland game birds, most waterfowl, raptors, blackbirds, crows, jays, and others. The 1897 law prohibited one from “having in his possession the body or feathers” of this same, circumscribed group of birds. No protection existed before 1818 and the nineteenth century laws that followed were characteristically narrow, weak, and subject to local veto. To make matters worse, public knowledge of the laws was scant and enforcement almost nonexistent.

In the first years of the new century, the Society was moving to strengthen its legislative efforts. In October 1902, the committees on wardens, legislation, and protection were consolidated into the "Committee on Protection," with Ralph Hoffmann as chairman. Also on this committee were Mrs. John W. Elliot, James Arnold Lowell, George Mackay, and Reginald Robbins. These directors represented the Society at the State House, making known board policies on different issues and suggesting legislation. Their first notable success was the Act of 1903 for the protection of herons and bitterns. This allowed the Fish and Game Commission to prosecute milliners who processed, displayed, or sold aigrettes. As it happened, George W. Field, who had become a director of the Society in 1902, was also a member of the Fish and Game Commission. Field was a biology teacher at the Massachusetts Institute of Technology, Chairman of the Massachusetts Fish and Game Commission from 1904 to 1916, and later an employee of the U.S. Biological Survey. Field kept the board apprised of the commission's enforcement proceedings. Public sentiment and legal strictures soon began to have an impact on the milliners. But the successful legislative work of 1903 was only a beginning. Like most victories won at the State House, the gains were often transitory. The campaign was a continuing one, not to be won in any single skirmish.

The other side of the Society's attack on the milliners was educational. If they could convince millinery users to not purchase aigrette-adorned fashions, and thus directly affect the market place, the directors would be well on their way to accomplishing one of their goals. To this end, they published a steady stream of informational circulars. The Society also sponsored hat shows which featured fashionable milliners. Ribbons were awarded for the best hats trimmed without the use of aigrettes or other plumage of wild birds. Slowly, but surely, they began to get their message across. In their 1910 Report to the directors, they stated "The long period of reckless waste of the nation's resources seems to be passing; there is a growing desire to preserve what remains" (document missing). But as always, it was two steps forward and one back. At the March 1914 meeting of the board it was reported that one of their own vice presidents, Mrs. John L. Gardner, was still wearing aigrettes in her hat. The motion carried "that the secretary be directed to write a letter to Gardner, asking if the report is true" (document missing). A response from Gardner advised the board that she wasn't quite certain what an aigrette was and suggested the "Society publish some

sort of explanation.” Furthermore, said Gardner, her aigrette was merely, “the kind made of horsehair or whalebone.” Not to be put off by fence sitting and claims of ignorance, the directors put down their collective foot:

“Resolved, that the Directors of the Audubon Society feel that the spirit of the Society is transgressed when the officers wear even artificial aigrettes which so resemble the genuine as to lead to the encouragement of the practice of killing egrets” (document missing).

New legislative gains were made between 1904 and 1907. The market gunners’ and milliners’ depredations of coastal birds were slowed by prohibition of the sale of shore, marsh, or beach birds in spring. Seasonal hunting of game birds was defined and loons on fresh water as well as eagles were put under protection. However, the protective measures of 1906 would be too little, too late to save the Heath Hen (*Tympanuchus cupido cupido*) from extinction.

In 1908, the state legislature passed a key bill that required hunters to obtain a license and gave game wardens the power of arrest. Ideally, this measure would institute controls over how much hunting was done, as well as provide much needed revenues for wildlife and habitat preservation. Reality, however, was something else. Forbush commented at the time that much of the hunting license money had been diverted to uses other than the protection of birds. One of the most devastating practices to bird populations was the hunting and trapping that took place during the breeding season. As early as 1906, directors of the Society made clear their policy on this issue: “... it is to the advantage of all concerned,” they said, “that spring shooting of all wild fowl be ... abolished” (Records of the MAS, MHS). To encourage anti-spring-shooting legislation, the Society helped pay for Forbush’s work in the legislature and collected petitions from the Audubon membership. In 1909, after a monumental struggle in the legislature, a law prohibiting spring shooting of ducks and geese was passed. Within the year efforts were under way to repeal this law. A newly formed group, the Gunner’s Association, collected their own petitions and took them to the politicians. In March 1910, Forbush spoke to the board about a bill that removed all protection from wild fowl and allowed their sale. Efforts of the Society helped to defeat this repeal initiative.

Sale of game caused considerable consternation among board members. In December 1911, Forbush discussed with the directors legislation proposed by the Fish and Game Protective Association to stop the sale of all wild game and prohibit shooting over live decoys. President Brewster, who presided at this meeting, was not in favor of stopping the sale of all game and explained that he could not serve on any committee looking into this matter. Ultimately, Brewster (letter, Brewster to Directors, 4 July 1913; MCZ) suggested that he should resign, "as he did not feel as the majority of the board did about legislation in regard to game birds . . ." It was at this point that Minna Hall wrote to Brewster asking that he reconsider. While Brewster had stayed on for two more years, differences of opinion had continued to exist. In December 1913, William Brewster resigned as president of the Massachusetts Audubon Society.

LEADERSHIP AND A MATURING SOCIETY

Edward Howe Forbush (1858-1929).—If anyone could bring to the Society the prestige and respect provided by William Brewster, it would be Edward Howe Forbush. Forbush began his work with the Society in 1907 and was elected to the board of directors in 1908. Forbush continued as a director through 1914 when he succeeded Brewster as president of the Massachusetts Audubon Society, a position he retained until 1925. Forbush was born in Quincy, Massachusetts, and moved to West Roxbury in 1865. Forbush's own description of his childhood haunts and habits are reminiscent of Brewster's Cambridge:

"Every fine morning in spring I was away at daybreak through dewy fields and woods, listening to a hundred bird voices and watching the birds and squirrels. Then after about four hours spent in the woods, back to breakfast and school. Holidays were passed in fishing on an old, partly submerged log on the treacherous floating brink of Muddy Pond, snaring little pickerel in the brook, catching butterflies or gathering birds' nests, minerals or wild flowers. In autumn came nutting, setting snares, and, in time, that pastime of all young savages—hunting." (Forbush, quoted in May 1929:xx-xxi).

At the age of 16, a precocious Forbush landed the job of curator of ornithology at the Worcester Natural Science Museum. During the 1880s, he supplied Worcester's newspapers with numerous articles on popular ornithology and bird conservation. An apprenticeship with C. J. Maynard in taxidermy and ornithology, collecting trips to Florida and the Pacific, and the directorship of the Worcester Natural History Camp (the first of its kind in America) completed Forbush's education. Like Brewster, Forbush's passion was field natural history. Indeed, the two men were close friends. Forbush was a corresponding member of the Nuttall Ornithological Club and a frequent guest at Brewster's "October Farm." Here, from Brewster's cabin and boat house on the bank of the Concord River, the two men set out on canoe trips up and down the Sudbury River Valley. It was, after all, just such field work that provided the motivation and experience for both of these men's organizational endeavors.

Forbush's first state job was as director of Gypsy Moth suppression in Massachusetts. In 1893, Forbush, who was rapidly gaining a reputation as an expert on agriculture and birds, was appointed ornithologist to the Massachusetts State Board of Agriculture. In 1907, he became New England field agent for the National Association of Audubon Societies and in this role first worked with the Massachusetts Audubon Society. Between 1908 and 1920, Forbush held the position of Massachusetts state ornithologist. In addition to his organizational commitments, Forbush found time to lecture and write about his favorite subject. Among his numerous publications, three of the most important are *Useful Birds and Their Protection* (1907), *A History of Game Birds, Wild-Fowl and Shore Birds of Massachusetts and Adjacent States* (1912), and *Birds of Massachusetts and Other New England States* (1925, 1927, 1929). That all of these works were published by the Commonwealth is a tribute to Forbush's skill in legislative matters. The educational impact of these volumes, as well as the attention they brought to the cause of bird preservation are incalculable. Forbush's magnum opus, *Birds of Massachusetts*, combines such a wealth of knowledge, anecdotal field experiences, and artistic talent, that it remains today one of the finest bird books ever created. In 1914, when Forbush assumed the presidency of the Massachusetts Audubon Society, he brought with him the skills of ornithologist, educator, and preservationist (May 1929).

Federal legislation.—A major flaw in early state legislation was that it operated without the benefit of any national policy. Each state promulgated different laws which resulted in major difficulties in efforts to protect migratory species. Early in 1913, the Society reorganized the Protection Committee and elected George Field as chairman. Also on the committee were Forbush, Townsend, Robbins, and Packard. A major effort of the committee would be their work on federal legislation in coordination with the National Association of Audubon Societies. During this period, the Society provided funds for the National Association's work as well as for sending Field and Forbush to support two important pieces of federal legislation which were eventually passed. One was the 1913 tariff bill passed on 3 October 1913, which contained a proviso that prohibited the importation of the plumage of wild birds for other than scientific or educational purposes. This legislation allowed customs officials to shut down the enormous trade in aigrettes imported from Europe and the tropics. Earlier in the year, the Weeks-McLean Law, was signed into law. This allowed for the protection of migratory species, including non-game birds, on a national basis. The bill's immediate effectiveness however, was negligible.

Specific regulations needed to be agreed upon, funding was minimal, and the law's constitutionality was under question. One bright note was that Forbush was one of the men chosen to review the proposed regulations. Actually, the disposition of this bill was ultimately rendered moot in 1918 with the passage of the Migratory Bird Treaty Act, which enabled the 1916 convention for the Protection of Migratory Birds, popularly known as the "Migratory Birds Convention of 1916." In 1913, the Migratory Birds Convention was slowly winding its way through the legislative process. This Convention proposed an agreement with Great Britain (on behalf of Canada) to establish uniform seasons and bag limits for game birds, protect outright many other species including song birds, and prohibit the sale or possession of bird plumes, nests, or eggs. In 1916, just as it looked as if the Migratory Birds Convention would pass the Congress, a storm blew up. Sportsmen in Missouri were demanding that a clause allowing spring shooting be inserted. To make matters worse, a small group of legislators had convinced the board of the National Association of Audubon Societies that if they didn't go along with the proposed change, the congressmen would abolish the Biological Survey (the only federal department working for bird preservation). The NAAS board acquiesced.

The reaction of the Massachusetts Audubon Society was somewhat different. The Society quickly mobilized its resources in a determined effort to defeat this provision. E. H. Forbush, a long-time opponent of spring shooting, registered his displeasure by sending in his letter of resignation as New England representative for NAAS. Money was appropriated both for the Congressional campaign of Senator Weeks of Connecticut, a major sponsor of the act, and to fund George Field's work in Missouri. Field was able to report back to T. Gilbert Pearson, the National Association's coordinator in Washington, that the Missouri opposition was not important and that efforts should be continued to defeat this move. Although the bill was ultimately passed with the spring shooting language intact, in practice, hunting was not allowed after 15 January. The Migratory Birds Convention became law in December 1916 and, just as importantly, the enabling act, the Migratory Bird Treaty Act, was signed by President Wilson in July 1918. This important federal legislation provided the framework for future bird protection laws and gave the states a uniform context for their own laws (Barrow 1998, Pearson 1933).

Habitat preservation and Moose Hill.—Before the first formal meeting of the MAS, Minna Hall wrote to William Brewster about several matters pertaining to the Society's formation. In her letter (Hall to Brewster 13 July 1896; MCZ), Hall inquired, "Would it be possible to protect a heronry for a time so that the birds would increase again . . . and would the expense be great?" Although habitat protection and preservation would not become a major focus of the Society's efforts for many years to come, the board expressed concerns about habitat management from the beginning. The 1897-1902 report mentioned that the Society had donated money to the Thayer Fund, an Atlantic coast effort to protect gull and tern nesting habitat (document missing). In 1902, the board voted to support efforts of the National Association of Audubon Societies to sponsor legislation to protect certain "forest preserves" and game in the lower 48 as well as in the District of Alaska. The directors also worked with the Fish and Game Commission in 1911 to pass legislation that established some public lands as state reservations, where birds and game were protected year round. The Society's initial steps in acquiring its own land began in 1916. In April of that year, the board voted to accept George Field's offer of his Moose Hill estate in Sharon

... THE ...
MOOSE HILL
BIRD SANCTUARY

SHARON
MASSACHUSETTS

GEORGE HARRY HIGBEE, Superintendent



OWNED AND OPERATED

BY THE
MASSACHUSETTS
AUDUBON SOCIETY

Figure 9. An early brochure advertising the Moose Hill Bird Sanctuary in Sharon.

for use as a bird sanctuary (Figure 9). In 1918, Harry Higbee was hired as the resident warden of the Moose Hill Bird Sanctuary. During the next several years, adjoining lands were added resulting in a 2853-ha (7050-acre) property. Largely through the efforts of Harry Higbee, Moose Hill gradually became a working sanctuary (Figure 10). Nature trails, bird feeding stations, a small museum, and a library made the



Figure 10. Photograph of an early Massachusetts Audubon event at the Moose Hill Sanctuary.

Society's first sanctuary a gathering place for bird students. The Directors reported that in 1920 some 2600 visitors were welcomed at Moose Hill (Directors 1921).

Wardens.—Besides its educational, legislative, and habitat preservation efforts, the Society occasionally used direct intervention to protect bird populations. In 1899, the directors agreed to take over George Mackay's program of monitoring coastal and island breeding colonies of gulls and terns. In subsequent years, the Society provided funding for wardens at these and various other sites in Massachusetts. The wardens kept illegal hunting at a minimum and posted many areas with signs provided by the Society.

Winthrop Packard—secretary-treasurer (1913-1936).—Important changes took place in the Society between 1912 and 1917. In August 1912, Winthrop Packard was hired as field secretary. The concept of having a field representative went back to Ralph Hoffmann's successful sojourns in 1908 and 1909. In 1910, Ernest H. Baynes carried on the work, especially in the western portion of the state, as an itinerant lecturer for the Society. Packard, an author of nature articles and part-time field agent for the NAAS, brought a large measure of energy and enthusiasm to the job. Within less than a year, his lecturing and hand shaking had greatly increased the membership and brought new funds to the Society's treasury. In 1913, Packard replaced Jessie E. Kimball as secretary-treasurer, who had served in that position since 1905. It was also in 1913 that the Society moved its headquarters from the library to the basement of the Boston Society of Natural History building. With this move, the Society now had a new address, 66 Newbury Street, as well as its own entrance. Here, Packard and other Society workers welcomed visitors who came to browse among the books and journals, enjoy the bird exhibits, or just ask questions. Packard continued to bolster the Society's rolls and finances. By the second decade of the new century, a growing treasury allowed for new projects. Packard also established the *Bulletin of the Massachusetts Audubon Society* (see below). Winthrop Packard continued to work for the Society until 1936.

Bulletin of the Massachusetts Audubon Society.—One important Packard innovation was the *Bulletin of the Massachusetts Audubon Society for the Protection of Birds* (*Bulletin*). Packard, although his name does not appear in the journal as editor, served as editor until his retirement in 1936. In February 1917, Volume 1, Number 1 of the *Bulletin* was published. This issue contained the following statement of purpose:

"The *Bulletin* will chronicle the affairs of the Society from month to month, will report items of interest concerning birds, such as the appearance of rare species locally, will keep its readers informed as to State or Federal legislation and briefly note items of interest about birds throughout the world."

The subscription rate was 1\$ per year. The first issue also contained a report of activities of the Society since 1915. From time-to-time the *Bulletin* listed the executives of the Society, including the long list

of vice-presidents, the report of its directors, the treasurer's report, membership lists, and local bird notes. Beginning with No. 2, the *Bulletin* included numerous letters detailing local bird sightings and behavioral notes, and short anonymous articles about birds, presumably written by Packard. This monthly (excepting July, August, and September) magazine provided a regular means of communication between the Society and its members, including notices of Society events.

Through the years new features were incorporated in the *Bulletin*, such as a series of reports by E. H. Forbush, entitled "Winter birds," or "Birds of early March." In 1918, a paper "Birds of Moose Hill Sanctuary" by H. G. Higbee marked the beginning of publishing formal papers. By 1919 obituaries and book reviews began to appear. By 1921 commercial advertisements for bird house and books were included. In 1923 a paper "More bird-banding notes" reported returns of winter-banded juncos and sparrows (Harrington 1923), indicated that the *Bulletin* was publishing notes of scientific value.

Packard announced his resignation as editor of the *Bulletin* in 1936 and Carl Buchheister became editor as well as secretary-treasurer of the Society. In 1938 the *Bulletin* was still a slim 16 pages, but under Buchheister the journal was professionalized by the inclusion of a series of scientific papers by prominent ornithologists. For example, in 1938 Ralph S. Palmer wrote about Penobscot Bay terns, Ludlow Griscom discussed increases and decreases in Massachusetts birds (Griscom 1938a), and Lawrence Kilham reported on nesting eider ducks in Penobscot Bay. Also in 1938, Griscom began a long series of papers on spring and fall migrations (Griscom 1938b).

In 1939 C. Russell Mason became secretary-treasurer and editor of the *Bulletin* when Buchheister took a position with the National Association of Audubon Societies (now National Audubon Society). Mason continued the professionalization of the journal and expanded its size, reaching 418 pages for nine issues in volume 35 (1951). A "President's Page" was added, and a "Sanctuary news" section as well. A volume's pages were numbered consecutively, rather than beginning each issue with page 1, and the flow of papers by prominent ornithologists continued. For example, in 1941 Oliver L. Austin, Sr. published a paper on Cape Cod terns, and Roger Tory Peterson published a paper entitled "Billions of birds." Each issue began with a high-profile paper.

By the time that Mason resigned in 1957, the *Bulletin* was arguably one of the most important regional bird journals in North America.

Incorporation.—Soon after Edward Howe Forbush assumed the presidency in 1914, the Society took steps to form a corporation. Efforts to incorporate had actually begun in 1909 as the result of questions concerning bequests to the Society. However, this petition for incorporation was turned down because there was no provision for election of officers by the membership. The matter was tabled for five years, but in 1914, the legal difficulties were settled. On 14 December 1914 the incorporators met to elect officers and set down their bylaws. The Massachusetts Audubon Society was incorporated under Massachusetts law in January 1915 (Directors 1917). The first meeting of the new corporation was held on 23 January 1915.

Moves.—The Society's first office space was a section of the library of the Boston Society of Natural History (later to become the Bonwit Teller Building) on Newbury Street. In 1913, as a result of expanding programs and the need for more space, MAS rented the basement of the same building. This provided the staff with much needed elbow room, their own entrance, and a new address, 66 Newbury Street. This basement headquarters was to serve the Society for three decades. Certainly, the move from shared space to rooms of its own was an improvement. The basement location was, however, far from ideal. Juliet Kellogg, a curator of birds at the Boston Society of Natural History in the 1930s, and later a member of the MAS board of directors, remembered the 66 Newbury Street cellar as "the dirtiest, crummiest, awful place – perfectly terrible" (pers. comm. to RKW). No doubt the growing staff was relieved by the society's 1943 announcement that it had found a new home.

The new headquarters, at 155 Newbury Street, was a three-story building with a spacious display room, enlarged library, and educational offices on the first floor. The second floor housed the secretary's office and business offices, and the third floor was for exhibits. Thanks to Ruth Alexander's interior decorating skills, 155 Newbury Street became a comfortable and attractive place for both staff and visitors. The membership was invited to tour the new facility at an open house on New Year's Day, 1944.

The Voice of Audubon—KENmore 6-4050.—During the 1940s and 1950s, the popularity of birding grew rapidly. One of the jobs of staff members at 155 Newbury Street was to answer an ever-increasing number of calls regarding this bird or that. Questions about bird identification, rare sightings, and birding hot spots were often taken by staff member Ruth Emery. By the mid-1950s, the number of calls and time required to answer them were leaving little time for Emery to deal with her other responsibilities. Fortunately, Henry Parker, who was not only a board member, but an official at New England Telephone, had a solution: New England Telephone's innovative automatic answering and message system. After some preliminary investigations by Emery and Parker, the Society decided to purchase the system, and the "Voice of Audubon" was in place at the beginning of 1955. Members and the public could call KENmore 6-4050 and get Ruth Emery's recorded message about the latest bird sightings, tips on where to bird, and field trip schedules with time at the end to leave their own message on bird sightings. The recording was updated three times a week. It wasn't long before the "Voice" was receiving calls from all over the country from birders and business groups interested in learning about the new system. Again, the Massachusetts Audubon Society had been first with an idea which was to be copied nationwide.

Legislation.—The 1916 Convention for the Protection of Migratory Birds and the 1918 Federal Migratory Bird Treaty Act had gone a long way toward providing a legal structure for bird protection in North America. President Forbush (1924) asked the membership for support in passage of another important piece of federal legislation, a bill that was to become the Migratory Bird Conservation Act of 1929 (also known as the Norbeck-Anderson Act). Forbush pointed out that outright protection of birds was not enough to insure their future. Forbush was concerned with the ongoing destruction of habitat. The continued loss of foraging and resting habitats would destroy bird populations as surely as rifle and shotgun. Early in 1929, one month before E. H. Forbush's death, President Calvin Coolidge signed the Norbeck-Anderson Act. This legislation provided funding to place one hundred wetland wildlife sanctuaries under federal protection to preserve a portion of this critical habitat. Interestingly, one of the major shapers of this law was the National Committee on Wild-Life Legislation whose treasurer was John C. Phillips, formerly a director of MAS.

During the 1930s, MAS was also concerned with state laws. Constant vigilance and action were needed during this period to prevent change or repeal of existing state bird- and habitat-protection laws. One group was making a determined effort (House Bill 485) to legalize hunting of Red-tailed (*Buteo jamaicensis*) and Red-shouldered (*B. lineatus*) hawks, Merlin (*Falco columbarius*), and Peregrine Falcon (*Falco peregrinus*), as well as Snowy Owls (*Bubo scandiacus*). From the proponents point of view, this bill was ill-timed. Interest in hawks was particularly keen at this time. The establishment of Hawk Mountain Sanctuary in Pennsylvania in 1934, a pioneer effort in raptor conservation, featured prominently in the pages of the *Bulletin* (e.g., Braun 1935). J. A. "Archie" Hagar's work with the nesting falcons in western Massachusetts and the hawk flights at Mount Tom also educated Massachusetts citizenry to the delights of raptor studies. Ultimately, a coalition of interested groups defeated the opposition. In 1937 and 1938, legislation to repeal protection for these hawks and owls was defeated in committee.

By mid-century, Executive Director Mason would characterize MAS as having moved through the eras of protection of birds and protection legislation. While much had been accomplished during the first 50 years of the Society's existence, other legislative battles lay just ahead. The continuing destruction of critical habitats was still very much a real and present danger; ahead lay the fights over pesticides, acid rain, and other potentially catastrophic threats to the environment.

Robert Walcott—president, 1925-1955.—In April 1925, the board of directors accepted the resignation of Edward Howe Forbush as president of the Massachusetts Audubon Society. Forbush, who had led the Society for over a decade, would devote the remainder of his life to work on his magnum opus, *The Birds of Massachusetts* (1925-1929). In June, the board unanimously elected Robert Walcott to succeed Forbush as the Society's third president. Although not a professional ornithologist, as Brewster and Forbush were before him, Walcott brought to the presidency an enthusiasm for birds nurtured from his youth. Further qualifying him for leadership in the Society was his administrative experience as Special Justice of the Cambridge Court and his active involvement in a wide range of community affairs.

Walcott was born in Cambridge in 1874, received degrees from Harvard in 1895 and 1899 and soon thereafter began his legal career

which was to span half a century. He joined the Nuttall Ornithological Club in 1891, when William Brewster, the club's founder and first president, was still very much in charge (Batchelder 1937). While many club members were amateur ornithologists, all had a serious interest in "scientific ornithology" (Davis 1987). Walcott's interest in birds seemed, if anything, to grow with the man. Carl Buchheister remembered Walcott as a man interested in "more and better birds" (pers. comm. to RKW). While some recall the judge's Yankee austerity, others were quick to note the respect this man inspired as well as his kindness and generosity (Anonymous 1952a).

For 30 years, Robert Walcott served as president of the Society. While the day-to-day management of the Society's business was the job of the secretary-treasurer and later the executive director, Walcott's role was to provide dignified leadership and a steady hand; this he did admirably. Besides the judge's administrative duties at the board meetings, he kept in touch with the membership through the pages of the *Bulletin*. "The President's Page" gave Walcott the opportunity to express Society positions and policy on a variety of matters. Whether he was speaking on behalf of Wood Ducks (*Aix spoua*) or wetlands conservation, or making another plea for funds to acquire a sanctuary, Walcott seldom minced words. His direct, unequivocal appeals often resulted in action.

When Robert Walcott died in 1956, less than a year after leaving the presidency of the Society, the board of directors paid him the following tribute,

"To the Honorable Robert Walcott, the Massachusetts Audubon Society owes a deep debt of gratitude. For 30 years, Judge Walcott, as president of our Society, guided us with firmness and understanding in accord with the best New England tradition and with a high sense of propriety. Under his leadership, we have grown in stature and strength and have gained the respect of all who are interested in conservation, particularly in the protection of wildlife of our region and its environment. We have benefited enormously from his untiring efforts and devotion" (Directors 1957).

Francis H. Allen.—In the early 1930s, an unpublished author came to Houghton Mifflin Company with a manuscript on birds. The author was Roger Tory Peterson; the man largely responsible for convincing

Houghton Mifflin to publish the work was Francis H. Allen. The year 1934 marked not only the publication of Peterson's *A Field Guide to the Birds*, but also the end of Allen's half-century career with Houghton Mifflin in which he rose from office boy to senior editor.

Allen was born in Jamaica Plain [now part of Boston] in 1866. Although he attended the prestigious Roxbury Latin School and received honors on his entrance examinations for Harvard in 1884, Allen's family could not afford college costs. Allen soon, however, made his mark at Houghton Mifflin. As a young boy, Allen had developed an interest in the birds of the local fields and woodlands of Jamaica Plain and West Roxbury. This interest matured, and like many of his ornithologically-minded contemporaries, he was eventually elected to membership in the Nuttall Club. For nearly four decades Allen was vice-president of the NOC. His ornithological interests brought him together with many of the leaders in the field including Brewster, Townsend, Taverner, and Thayer. Although generally considered a mild-mannered, soft-spoken gentleman, Allen was not one to avoid combat, at least verbal combat. His energetic debates with none other than Theodore Roosevelt, another NOC member, over the relative merits of Thayer's theories regarding protective coloration in animals, are well documented in ornithological literature (Balch 1945).

Francis H. Allen's career with the Society spanned more than half a century. He saw the Society transformed from the fledgling organization of the 1890s to a nationally prominent force in conservation by the 1950s. Allen was appointed to the board of directors in 1899 and in 1920 became chairman of the board, a position that he held for more than three decades, before retiring in 1953. Allen's role with the Society in the early days has been discussed elsewhere. However, during the decades of the 1930s and 1940s in addition to his administrative duties, Allen was regularly involved with the *Bulletin*. His extensive knowledge of ornithology and ornithologists, as well as his editorial skills were important contributions to the monthly magazine. Francis Allen's work with the Massachusetts Conservation Council, and the organization which preceded it, was also helpful in promoting the work of the Society (Walcott 1953).

In the Society's archives (Records of the MAS, MHS) is a draft manuscript written by Allen that records the early years as well as outlining the history of the second quarter century. Innovative educational programs, increasing efforts to protect the land, cooperation with other

agencies, legislative battles, and new conservationists are all part of his story (Allen undated). Allen never completed his history of the Society. His perspective was unique and his talents were many. Fortunately, even the relatively bare outline which he left, highlights important events and people in the Society's history and touches on the important struggles, both educational and legislative, in which the Society had a leading role.

Carl W. Buchheister—secretary-treasurer (1936-1939).—By the 1930s, Winthrop Packard had become an institution. In his role as secretary, for many years the only full-time professional on the staff, he had made many important contributions to the work of the Society. Not only was he in charge of headquarters, Packard also managed the day-to-day administration of most programs and represented the Society at numerous professional meetings and conferences. Among other things, Packard instituted the *Bulletin*, gave the first radio talks, and organized and ran the first summer nature camp. While Secretary Packard's achievements were numerous, he had, at times, been a liability to the Society. Packard was considered by some to be a "rabid protectionist," and certainly not above using the Society's clout to further this position. More than once, this encouraged divisiveness rather than cooperation between groups interested in conservation. By 1936, the board felt a change was needed. Packard had worked for the Society for nearly a quarter of a century and was 74 years old. Judging from the announcements made at the time, and the cool reception he gave his replacement, Winthrop Packard was not ready to retire. In October of 1936, however, Judge Walcott announced that the Society had hired Carl W. Buchheister as its new secretary-treasurer.

Carl Buchheister would be with the Society for only three years. His tenure, however, resulted in important changes and innovative programs which would continue well after Buchheister was gone. In a sense, the Buchheister years represent a watershed in the Society's development (Morgan undated). A transition of sorts took place during these years, from the founders' concerns with specific conservation and legislative programs, to a more general approach to environmental issues and education. Buchheister was an educator, not an ornithologist. When hired by the Society, he was teaching at a preparatory school on Long Island, New York, and running the NAS summer camp at Hog Island, New York. Juliet Kellogg, later to become a member of the board of directors, remembered Buchheister as a "master turner-

arounder of interests" (Kellogg pers. comm. to RKW). The new secretary-treasurer was a people person, one who was able to marshal diverse groups to pull in the same direction. While Packard gave short shrift to hunters and sportsmen, Buchheister sought and encouraged their cooperation. Carl Buchheister also revamped the Society's education program. Under his leadership, learning became a cooperative effort between teacher and student. Although birds and birders were still to have an important place in the Society, Buchheister encouraged a more general approach. Buchheister was a good learner himself. He knew how to call on the talents of such individuals as J. A. "Archie" Hagar, Ludlow Griscom, and Mary Rutter to accomplish the work of the Society. In 1939, Carl Buchheister accepted a post with the NAS as assistant to John H. Baker.

C. Russell Mason—executive director (1939-1957).—Late in 1939, the board announced that C. Russell Mason would replace Carl Buchheister. Mason came to Massachusetts from Florida. He had grown up in Pennsylvania and taken degrees in horticulture from Pennsylvania State College and Purdue University. For a number of years, Mason worked for agriculture companies and then, in 1936, he was elected president of the Florida Audubon Society. Under Mason's administration, Florida Audubon quadrupled its membership (Davis 1987).

The growth that Mason inspired in Florida was to be mirrored during his stay in Massachusetts. In 1939, when Mason began work at the Massachusetts Audubon Society, membership numbers were under 3000. Less than two decades later, in 1957 when Mason resigned, Society membership had more than doubled. Besides the growth in membership, Mason was largely responsible for the burgeoning educational program (Morgan undated). The Audubon staff grew from eight employees to more than 60 workers during this same period. As the Society grew in members and programs, the budget also grew. While the annual budget was \$25,000 in 1939, a decade later the figure was \$100,000 and, by 1959, the Society's annual budget was \$393,000.

In June of 1946, the board announced that Mason's title would be changed to executive director. In order to keep up with the growing administrative responsibilities, the Society also hired Donald C. Alexander to act as the new secretary-treasurer.

Among the numerous programs initiated during Mason's tenure were the publication of *Records of New England Birds* and the "Voice

of Audubon.” The story of the education program, the rapid increase in sanctuaries, and various other society projects is detailed elsewhere in this chapter and in Leahy et al. (1996). Suffice it to say that growth was the byword of the Mason era and that the decades of the 1940s and 1950s would redefine the scope and impact of the Society.

Cooperation.—One of the key factors leading to the successful establishment of the Society in the last decade of the nineteenth century was the coalition formed by the members of the board of directors. Academicians, sportsmen, ornithologists, and ladies of culture focused their often diverse opinions and perspectives in order to accomplish the goals of the Society. One divisive issue, never far from the surface however, was the subject of hunting. While there was general agreement on the Society’s efforts to curtail the useless slaughter of songbirds and other non-game species, differing positions were held and expressed regarding sport shooting and even hunting for the market. Vigorous discussions were held by the board over the question of protecting waterfowl and other game species. The ornithologists carefully protected their rights to collect birds for scientific purposes while at the same time arguing for the sportsmen’s and market hunters’ rights to hunt for pleasure and profit. President Brewster’s stance was generally more liberal with regards to the hunters than the majority of the board. To the board’s credit however, they were able to maintain a consensus which accommodated the views of the various groups, and get on with the work of the Society.

The hunting issues came to the surface again in the early 1920s. While Brewster had been on the hunter’s side of the table, Secretary Packard took an opposing view. Packard represented an element in the Society that was radically opposed to sport shooting. No doubt Packard was not alone. In 1924, Packard, acting on his own and without authorization from the directors, began a crusade to abolish the shooting of Bobolinks in the rice fields of the south.

The Bobolink/rice crop issue was a complex one. Forbush, in his *Useful Birds and Their Protection* (1907:323) wrote, “In the south, however, the Bobolinks, together with the blackbirds, cause an annual loss of fully two million dollars to the rice growers, and would destroy the whole crop were not all the hands on every plantation engaged during the ‘rice bird’ season in shooting or frightening the birds.” In 1912, Forbush went to South Carolina to see for himself. Forbush found evi-

dence that substantial numbers of Bobolinks were also shot for profit, in addition to those birds killed to protect the rice crop. By 1923, when the National Association of Audubon Societies investigated the affect of these practices on Bobolink populations, they found that while Atlantic coast Bobolink numbers had definitely declined, other regions of the country, particularly those where grain was grown, showed an increase of Bobolink numbers.

Whatever the merits of the case, Packard's campaign succeeded in raising nearly \$4000 to support efforts to ban all hunting of Bobolinks. Packard's enormous success, however, resulted in a significant backlash (Allen undated). Not only did he alienate sportsmen and farmers, Packard also succeeded in mobilizing the board of directors. Francis Allen, chairman of the board, summarized the Society's position:

"From its beginning, the Massachusetts Audubon Society has welcomed the coöperation of all persons interested in the preservation of bird species, and its membership and its board of directors have included persons of all shades of opinion as to man's duties to his feathered relatives, from sportsmen who see no harm in anticipating the fate that must finally overtake all the living to those whose antipathy to the taking of any form of life stops short only of mosquitoes and other such pests of low degree, and including ornithologists who approve of the 'taking' of specimens for scientific purposes but otherwise deprecate any killing of birds." (Allen undated:15).

Packard's rebuke was formalized in a policy statement in which the Society actively encouraged the participation and cooperation of sportsmen and their organizations. Implicit in the board's statement is the recognition that without the active support of these interests, little could be accomplished. It was important to define common goals rather than exacerbate differences. Soon after the Bobolink fiasco, and no doubt partly because of the dust it raised, the directors established a committee on cooperation.

The Committee on Cooperation would define and execute the conservation policy decisions of the Society. Most of Packard's \$4000 was channeled to a conservation fund to support the committee's various projects. From 1925 to 1933, the Committee on Cooperation joined with the Federation of Bird Clubs of New England and the Massachusetts Fish and Game Association to form the Associated Committees for

Wildlife Conservation (ACWC). Projects of the ACWC included the ill-fated attempt to save the Heath Hen on Martha's Vineyard, acquisition of lands for conservation purposes, and support of educational legislation, including bills in support of publication of Forbush's three-volume work on the birds of Massachusetts. In 1931, a committee from the state Grange joined the associated committees.

In 1933, the ACWC was superseded by the Advisory Council for the Massachusetts Division of Fisheries and Game. Members of the former ACWC were then joined by representatives of the Council of Sportsmen's Clubs and the Federation of Farm Bureaus. In 1936, the advisory council was in turn replaced by the Massachusetts Conservation Council (MCC). John C. Phillips, Francis H. Allen, and William P. Wharton represented the Society on the MCC. The MCC was particularly active in legislative matters and, in 1939, helped to pass a bill that resulted in a state division of wildlife research and management. Joseph A. Hagar, long active in research and conservation projects as the state ornithologist, became director of this new division. The MCC also sponsored the conservation van. This classroom on wheels brought the conservation message to camps throughout New England. As important as any of its specific projects was the forum the MCC provided for the exchange of ideas and views of the various members.

EDUCATION

From its inception, education had always been a major goal of the Society. The initial efforts directed at abolishing the plume trade were soon complemented by a host of other programs, including bird charts, traveling libraries and lectures, and numerous publications (Figure 11). The *Bulletin*, instituted in 1917, added a new dimension to the educational thrust by providing a regular means of communication with the membership. The *Bulletin* issued a steady stream of articles on bird and mammal biology, descriptions of conservation programs, and information on legislative efforts. Moose Hill Sanctuary was also intended as an educational facility, a model wildlife reserve to be copied throughout the state.

During the second quarter of the twentieth century, however, major changes in the educational methods of the Society would be instituted. Early efforts focused largely on creating and disseminating massive



Figure 11. One of the many booklets produced by the Massachusetts Audubon Society in its early years.

amounts of information. Thousands of leaflets, pamphlets, notices, and other publications were written, printed, and distributed to any and all who might show interest (Figure 12). The decades of the 1930s and 1940s would see the Society hire, train, and send into the field, a growing corps of educators to carry the word personally from one end of the state to the other. While the flow of printed information was hardly curtailed, the word would now be carried by numerous Society workers as well as by mail.

Summer camps.—The seeds of the coming educational changes can be found in the announcement of April 1926 of a plan to hold a summer camp at Echo Bay at Mount Desert Island, Maine (Packard 1926). Under the direction of Winthrop Packard, the Society would conduct a

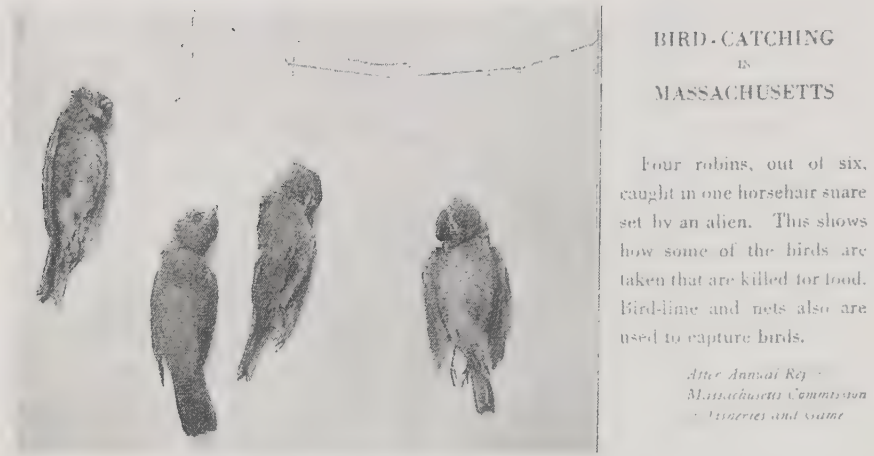


Figure 12. One of the early educational brochures produced by the Massachusetts Audubon Society in its preservation of birds efforts.

two-week program focusing on bird and plant study. Although the idea of a nature camp was certainly not revolutionary, the decision by the Society to have its staff apply the methods of direct teaching in a field studies situation was a departure from a previous inclination to let its publications do the teaching. For the next decade, through 1936, the Society held this annual summer workshop, first at Echo Bay and later at Cape Rosier on Penobscot Bay.

Other direct teaching programs were begun by the Society in the late 1920s. In 1926, Packard began a series of weekly radio programs on WEEI as part of the "Big Brother Club." These broadcasts featured bird news, notes, stories, and study for thousands of young people. Although Packard continued these broadcasts for only three years, they represent one of the Society's earlier attempts to use staff members as teachers.

L. Raymond Talbot, Harriet Goode, and the direct teaching program.—At the end of 1929, the Society made an even greater commitment to developing a direct teaching program. L. Raymond Talbot was hired as the educational field agent to lecture at high schools throughout the state. Talbot's review of his first year characterizes the immediate success of this program. "When I undertook to reach the older

pupils, in the high schools, I realized it was an experiment . . . I hardly knew what to expect. My doubts were soon dispelled . . . I was engaged to devote three days per week—half time—to this work; I am actually putting in five days nearly every week . . .” (Talbot 1930:4). Talbot’s activities provided much-needed supplement to the active junior Audubon program which was being directed by Harriet U. Goode. Initially, salaries for both Goode and Talbot were shared by MAS and the NAAS. By 1930, Harriet Goode was also going directly to schools to deliver lectures and assist teachers in forming bird-study classes. For the next decade, Talbot and Goode built the Society’s program in the public, private, and parochial schools. Each gave hundreds of lectures yearly reaching thousands of students. Talbot instituted a small monthly newspaper, *Bird News for the School*, as a means of keeping in touch with his audience. By 1936, these two industrious teachers were speaking in classrooms annually to more than 100,000 students in Massachusetts.

A new direction.—Ironically, in 1937, after Carl Buchheister had taken the reins from Winthrop Packard, the growing demands of the school program were becoming a liability. Secretary Buchheister reported to the membership in 1938 that “Our Educational Field Agents . . . have full schedules and cannot possibly meet all the demands for their services” (Buchheister 1938:3). As a result of increasing demands and Buchheister’s feeling that the lecture technique might be improved upon, the new secretary began to reevaluate the Society’s educational methods. In 1939, Buchheister announced that the Talbot/Goode budget was being cut in half and that a major rethinking of the educational program was in progress. Buchheister’s goal was to give the learners a more active role in the educational process. The passive audience of the traditional lecture format was not the answer. One activity instituted during Buchheister’s tenure was the “Wildlife Conservation Essay Contest.” High school students from Essex County towns began this project in 1939. Several hundred submissions were received the first year and the winner was awarded a scholarship to the Audubon Nature Camp. Buchheister also hired Mary E. Rutter whose teaching style was both engaging and interactive. Nature clubs, which took participants into the field, were also begun in various private schools. During this same period, Elizabeth Foster assisted the secretary in reformulating the educational program. Foster joined the MAS board in 1939 and became

an important spokesperson for education. While Carl Buchheister served as secretary for only three years, he was able to begin important changes in the educational methods of the Society, ones which ultimately involved the learner in a more active way.

C. Russell Mason and education.—Late in 1939, when Buchheister left MAS, his replacement was C. Russell Mason, who was to become an even more active proponent of education. Stressing what he characterized as modern teaching methods, in the following two decades, Mason assembled a veritable army of teachers. He began by holding a series of educational conferences with teachers and administrators to determine what they thought was needed that the MAS might provide. In outlining MAS priorities he argued (Mason 1942:14): “. . . that our educational program should, and does, rank first in importance.” Not only did he personally take to the stump, delivering numerous talks each year, but he hired several teachers to help with the growing nature lore and conservation courses. Evelyn Bergstrom went to work in the Essex County schools, Dorothy Snyder organized and led the Berkshire efforts, and Frances Sherburne helped with various youth groups.

Educational programs continued to expand, even during the war years. A major article in the *Bulletin* (Anonymous 1944) describes how the Society was providing special training for its teachers at such places as Cornell University and the National Camp for Leaders at Sussex, New Jersey. In the classroom, teachers were employing numerous educational aids, stuffed birds, plant specimens, and the like, to get their message across. Curriculum was specifically designed which related to the ongoing courses in the more traditional subjects of math, English, and history. Efforts were also being made to take students outdoors for firsthand nature study. MAS was also having some success in convincing the local school systems to bear a portion of the salary costs for Society teachers. Early in 1945, Mason reported that the educational staff had, in five years, grown from one part-time teacher to eight full-time educators. Among the new teachers was Emily Goode, daughter of Harriet Goode, who had directed the junior Audubon Program in the 1920s and 1930s. “Schoolscope,” a regular feature of the *Bulletin*, kept the membership in touch with the numerous educational activities. The end of the war provided a new pool of teachers for MAS and it was at this time that Douglas Sands began work on a part-time basis.

The school program continued to grow during the late 1940s. One question that began to be asked by the MAS education committee as well as the membership, was why, if natural history education is so important, do local schools not carry the burden of teaching these subjects as part of the normal curriculum? Even the board admitted that MAS, a private organization, could never hope to reach all public school students in Massachusetts. Despite the finite resources of MAS, the board and Mason were generally agreed that its programs provided models demonstrating what was possible in the realm of natural history education. They were hopeful that ultimately, state education leaders would see the benefits and take on more of these responsibilities themselves. Two large problems that mediated against such an eventuality were the lack of properly qualified teachers and the decentralized school system in Massachusetts. MAS urged its membership to work on the second problem by contacting local school committees and discussing the value of these programs. The first stumbling block, teacher training, was something the Society could approach directly.

Cooperation with the State Department of Education soon began to develop new curricula for science education in the elementary grades. Another project, begun in 1948, was the "Natural Science Workshop." First held at Rivers Country Day School and later at Cook's Canyon, these workshops trained teachers, camp counselors, and other youth leaders in the methods and materials for natural history education. Audubon hoped to build a core of qualified leaders with these efforts. William G. "Cap'n Bill" Vinal played an important role as one of the workshop leaders. Meanwhile, classroom work was supplemented by a series of summer experiences. By mid-century MAS was running five natural history day camps at their sanctuaries as well as at Palmer State Park in Topsfield.

Looking back over his first decade with Audubon, Mason could point with pride to the educational program. A dozen full-time teachers were working in 90 Massachusetts communities. MAS teachers had also been invited to bring their programs to schools in Rhode Island and New Hampshire. Florida and New Jersey had adopted in-school curricula based on the MAS model. Like other programs pioneered by the Society, their educational efforts were receiving national attention. In Director Mason's review of 1953 he stated, "We have passed successfully through the eras of protection of birds, and legislation necessary to

that end, into a period when conservation education for young and old is our main objective" (document missing). Mason continued to increase MAS involvement in the schools through 1957 when he left the Society. Near the end of Mason's tenure, 450 classrooms in 100 cities were being serviced by 24 Audubon staff members.

Besides the summer day camps at various sanctuaries, MAS instituted a residential camp for boys and girls at Cook's Canyon in Barre in 1949. Called Wildwood Nature Camp, this popular summer activity soon attracted many campers. Wildwood Nature Camp was in continuous operation at the Barre location for 33 years.

MAS also stepped up its adult education programs in the 1950s. Since its inception, the Society had organized and run birding field trips to various birding "hot spots" around the state. Increasingly during the twentieth century, cars gave these groups a mobility that nineteenth-century birders lacked. In the 1940s, Ruth Emery and Arthur and Margaret Argue, among others, led these popular trips. Busses were hired during the war years to save on gas. In the late 1940s and early 1950s, the rank of birders swelled. To answer a growing need, MAS offered courses in bird identification and three more general courses on basic biology: "The Three Kingdoms," "The Web of Life," and "Ecology Workshop."

MAS experimented with radio as an educational tool several times. Packard's pioneering broadcasts of the 1920s were followed in 1938 by a series of shortwave programs on WIXAL by Juliet Richardson, David Garrison, and Carl Buchheister. In June 1955, the MAS education department announced that, in conjunction with the Children's Museum in Boston, the Society was sponsoring a television series titled "Discovery" on WGBH, Channel 2. Elizabeth Foster, a board member active on the Education Committee, added her support to this new experiment. Mary Lela Grimes of the educational staff had the major responsibilities for "Discovery," both on and off camera. While Grimes' inexperience was apparent in the earlier shows, the format and direction were gradually improved. Before its three-year-run was over, "Discovery" and Grimes had won well-deserved honors and several of the segments were broadcast in other parts of the country. Copies of this series were in demand by school systems around the country well into the 1970s.

Another aspect of the Society's education program was as an outgrowth of the annual lecture series. From Ralph Hoffmann's first pro-

gram in 1899, the series had invariably been well-attended. In early years it was usual for several thousand tickets to be sold for the lectures which were given at the Tremont Temple and Huntington Hall in Boston. The series continued in the 1920s and 1930s presented by a variety of important naturalists including Robert Cushman Murphy, George Miksch Sutton, Allan Cruickshank, Olin Sewall Pettingill, and Arthur A. Allen. In the mid-1940s, MAS expanded the series by offering presentations in five towns across the state. Also added in 1946, was a youth lecture series called "Tales of Wildwood"; this series was given at Boston, Worcester, and Northampton. In 1948, the lecture program took a new name and was billed as the Audubon Nature Series. During the 1950s, under the aegis of the National Audubon Society, the program maintained its popularity with such speakers as Roger Tory Peterson, Thornton W. Burgess, and Richard Borden. By the late 1950s, the Audubon Nature Theater was being presented nationally and in over a dozen towns throughout the Commonwealth.

SANCTUARIES

The transition from the early days of the Massachusetts Audubon Society, when programs focused largely on public education, to the second half of the twentieth century, when the responsibilities of land management also became an important focus of the Society, is told in the story of the sanctuary movement.

MAS lands had grown from 91 ha (225 acres) in 1916 to nearly 4050 ha (10,000 acres) in the late 1970s. Extensive educational programs had evolved at the sanctuaries. What began simply as havens for birds became sites for camps, workshops, and museums. MAS sanctuaries provided a place for interested students, both young and old, to learn about the natural world. The dilemmas of pesticides, acid rain, and population growth impacted the sanctuary movement from a distance.

Moose Hill.— In 1922 a major change took place at Moose Hill, the Society's first sanctuary. Headquarters were moved to the Briggs property, an adjoining 18-ha (45-acre) parcel of land which MAS purchased for \$8000. Harry Higbee continued as the resident warden, managing Moose Hill largely as a model sanctuary. Extensive landscaping was carried out and feeding stations were constructed to attract birds;

trails and exhibits were designed to attract visitors. As the annual reports indicate, Moose Hill became a popular place. For 12 years, Harry Higbee welcomed guests to Moose Hill, led bird walks around the property, and designed exhibits for visitors. In 1930, William A. Taylor took over the job of superintendent at Moose Hill. For nearly two decades, Taylor carried on many of the programs instituted by Higbee. Renovation of the Field Estate on the property provided a place to accommodate overnight guests and some sanctuary visitors remained for a week or more. Another popular project at Moose Hill was May Bird Day. Held at the height of spring migration, members and guests enjoyed this annual outing, complete with picnics, speakers, exhibits, and of course, bird watching.

Federation of Bird Clubs of New England.—While Moose Hill was the mainstay of the Society's sanctuary program in the 1920s, other properties played important roles in MAS activities during the 1930s. A brief notice in the October 1929 issue of the *Bulletin* recorded the death of Miss Annie H. Brown, a reclusive lady from Stoneham, who had developed a passion for natural history and the means to promote the work of conservationists. A year after her death, readers of the *Bulletin* discovered that Miss Brown had bequeathed MAS \$100,000, the largest gift to that time. In addition to this bequest, Brown left \$25,000 to the Federation of Bird Clubs of New England (FBCNE) for the purchase and upkeep of a wildlife sanctuary. The FBCNE used this money to acquire land at the south end of Plum Island near Newburyport. This purchase marked the beginning of what is today known as the Parker River National Wildlife Refuge.

The FBCNE held its first meeting in January 1924. The close relationship between this organization and the Massachusetts Audubon Society is evident from F. H. Allen's early note on the Federation published in the *Bulletin* (Allen 1926:15),

"Among the most effective forces for conservation today is that young but active organization, the Federation of the Bird Clubs of New England. Started only two or three years ago by two of the directors of the Massachusetts Audubon Society who saw the possibilities in the cooperative action of bird clubs and similar organizations in the interest of bird-protection, the Federation

soon found a fruitful field of work in the colonies of nesting seabirds along the coast of Massachusetts.”

Allen's history of the FBCNE (1934:5) states, “The aim of the Federation was to acquire sanctuary lands for the benefit of the public . . .” Working on its own and in conjunction with the associated committees and advisory council (see Cooperation), the Federation bought outright or was gifted land for conservation purposes. The 1930 Annie H. Brown bequest led to the purchase of 121 ha (300 acres) on Plum Island. Within four years, the Federation owned close to 487 ha (1200 acres) on Plum Island and the Society another 20 ha (50 acres). In the early 1930s both the FBCNE and MAS were involved in the successful fight to stop a proposed highway and toll bridge project; the plan was to run a highway the length of Plum Island and connect this to the mainland at Salisbury and Ipswich.

In 1936, the FBCNE merged with MAS and the latter organization received title to two sanctuaries, the Paine Sanctuary on Tern Island, Chatham, and the Annie H. Brown Wildlife Sanctuary on Plum Island. The Chatham site was then one of the most important tern nesting areas along the coast. This, as well as numerous other Cape nesting locales, was part of the O. L. Austin Ornithological Research Station (AORS) program. Established in 1930 by O. L. Austin, Sr. in South Wellfleet, the AORS carried on extensive bird-banding and tern research for a quarter century. Society members were kept up to date on findings and progress at the station through numerous articles in the *Bulletin*.

Plum Island.—The marshes, tide pools, and barrier beaches of Plum Island had long since established this locale as a premier nesting and staging area for birds and thus it was of great interest to birders. Ornithologists had been visiting this portion of Essex County for decades. C. J. Maynard led organized birding trips here in the nineteenth century. Maynard's policy of charging a fee may in fact have been the earliest example in North America of professional bird tours, a business which was to burgeon in the late twentieth century. The Society could not have wished for a more valuable or appropriate sanctuary. In May 1937, on the occasion of the Society's first outing to Plum Island, 85 enthusiastic birders spent the day at the new Audubon sanctuary.

In the early 1930s, the Bureau of the Biological Survey was looking for a suitable site for a federal wildlife refuge. Money had been

made available through the Migratory Bird Conservation Act of 1929 and the government wanted to add a northeastern component to its chain of refuges along the eastern seaboard. An early choice was the Parker River and Plum Island locale. Although the Society was initially opposed to this plan, and suggested that the Biological Survey (and its successor in 1940, the U.S. Fish and Wildlife Service) investigate the Ipswich area, the federal bureaucrats pushed their case. Ira Gabrielson, the first Director of the U.S. Fish and Wildlife Service (USFWS) in 1940, led the charge to establish the refuge. In January 1940, he addressed the annual meeting of the Society to give an overview of the federal refuge program. Joseph A. Hagar, Massachusetts state ornithologist, opposed the federal plan (Hagar 1945). He felt that proposed engineering features, mainly the building of extensive impoundments, would not accomplish their stated aim of providing fresh or brackish pools to encourage freshwater duck nesting (Davis 1994). While Hagar's objections were successful in stalling the project, the USFWS renewed its efforts during the war years. MAS eventually "saw the light" and backed the federal plan. Both C. Russell Mason and President Walcott spoke in its favor. In the "President's Page" of the *Bulletin* (1942:187), Walcott explained that the government could force the issue, taking the land by eminent domain, and thus the Society needed to do what was in its best interests. He further announced that the Society was ready to transfer the property to the USFWS for approximately \$35,000.

In hindsight, most observers feel that the subsequent history of the Parker River National Wildlife Refuge proved Hagar was correct in his assessment of the government's plan. Tidal conditions, storms, and ice floes made the maintenance of freshwater impoundments impossible. Not only were thousands of dollars spent to build the dikes but many hectares of precious salt marsh were destroyed in the process. Perhaps the ultimate winners were the birders. What is left of the impoundment system provides ideal birding and regularly attracts a diversity of species including many rarities.

Western Massachusetts.—Interest in western Massachusetts was evident in the earliest days of the Society. Ralph Hoffmann, the Society's first chairman of the board, made frequent trips west to build membership and spread the conservation message. In 1900, Walter Faxton and Hoffman published *The Birds of Berkshire County*,

Massachusetts. The Society's focus on the western part of the state intensified during the 1930s. The program to protect Peregrine Falcon nesting sites in the Connecticut and Housatonic valleys drew membership attention to western Massachusetts. The Society had long supported the position of the state ornithologist and during the 1930s Joseph A. Hagar held this post. Hagar's work to protect Massachusetts' largest nesting falcon featured prominently in the pages of the *Bulletin*. The Society's educational efforts were also reaching the western part of the state. L. Raymond Talbot and Harriet U. Goode acted as educational field agents bringing the conservation message to hundreds of school children including those in the western counties. The publication of *Birds of the Connecticut Valley in Massachusetts* by Aaron Bagg and Samuel Eliot, Jr. (1937) also rekindled interest in the bird life of the region.

Another western Massachusetts/Audubon institution was the Berkshire Campout. First announced in 1941 by Hendricks, this annual weekend gave "Easterners" a chance to explore the natural treasures of such places as Pittsfield State Forest and Mt. Greylock. After a brief hiatus during the war years, the campout was resumed in 1946.

An early feature of the Society's *Bulletin* was the annual reporting of bird lists from observers throughout the state. Birders from western Massachusetts regularly submitted their totals and by the mid-30s, Sam Eliot, Jr. was contributing a summary for the westernmost counties. Various other authors based in the western half of the state regularly contributed articles to the *Bulletin*; in December 1948, Bartlett Hendricks offered readers the first installment in an extensive primer on western Massachusetts bird life titled "Berkshire Birds."

Arcadia and Pleasant Valley.—During the 1930s and 1940s, the Society began to establish a permanent base in the western part of the state. The December 1932 edition of the *Bulletin* introduced its readers to two properties in western Massachusetts: Pleasant Valley Bird and Wild Flower Sanctuary in Lenox (Braun 1929) and Arcadia Sanctuary in Northampton (Eliot 1932). Arcadia, situated on an oxbow of the Connecticut River, was originally acquired by Leroy S. Combs as private hunting grounds in 1904. The extensive wetlands and marshes along the Connecticut River Valley flyway made this an important foraging area for numerous migratory bird species, especially waterfowl. Over the years, Combs made the transition from hunter to watcher and

gradually increased his holdings in the area. Eventually, Combs posted the land, cut trails, and built an observation tower. By the late 1930s, however, Combs was considering selling the property and at least one of the potential buyers was a gunning club.

Aaron C. Bagg's appeal to Society members (Bagg 1938:5) described the sanctuary and asked the question, "Will the Audubon Society buy this marsh and hire a warden . . . to guard it?" The alternative, said Bagg, was to convert it back "into a slaughter house for ducks and rails." While the Society lacked the wherewithal to make the purchase, it did agree to provide a full-time warden during the hunting season. Further progress was made in 1942 when Mr. and Mrs. Zechariah Chafee, Jr. gave the Society \$500 in memory of their son, Robert Searle Chafee. This money, as well as an additional \$4500, was to be used, if possible, for the purchase of a sanctuary in Northampton. At the beginning of 1944, the deed to the Arcadia Sanctuary was conveyed to the Society. The early work by Combs and the subsequent generosity of the Chafee family and trust resulted in the acquisition of this first important Massachusetts Audubon property in western Massachusetts. In May of 1944, the Society announced that Edwin A. Mason would become the sanctuary's first superintendent.

The Pleasant Valley Bird and Wild Flower Sanctuary in Lenox was also of interest to the membership. Established in 1929, the original 121-ha (300-acre) sanctuary was created by a group of Berkshire citizens as a bird and wildflower preserve, educational facility, and research station. John B. May's young protégé, Maurice Broun, became the sanctuary's first warden. Broun designed and cut the first trails through the property, began the museum, and did some bird banding. Broun left Pleasant Valley in 1934 to become the first director of the newly established Hawk Mountain Sanctuary in Pennsylvania. During this same era, reports on Pleasant Valley were printed in the *Bulletin*. Like Moose Hill, the Berkshire sanctuary soon began to attract large numbers of students, camp groups, and interested adults. In 1932, S. Morris Pell took over the duties of warden. In 1942, S. Waldo Bailey replaced George Wallace as director at Pleasant Valley. Within the year, a more formal relationship was created between Pleasant Valley, the Berkshire Museum at Pittsfield, and Massachusetts Audubon. Members of the two Berkshire organizations automatically enjoyed membership in the Society. Also, educational programs were carried on by the Society at the museum during the winter months and at the sanctuary

during the rest of the year. Dorothy Snyder was selected to coordinate educational programs. With the help of Stuart C. Henry and G. Bartlett Hendricks at the museum, Mrs. Lawrence Miller and Bailey at the sanctuary, as well as Shirley B. Howard, Snyder soon instituted an ambitious conservation and nature-lore program in Berkshire County schools.

The growing ties among the three organizations were evidenced on the inside front and back pages of the *Bulletin*. Added to listing of the Society's officers and governing boards were notices of the parallel administrations for the Berkshire Museum and Pleasant Valley Sanctuary. During 1946, Pleasant Valley added nearly 81 ha (200 acres) of land and hired a new director, Alvah W. Sanborn. In June 1950, the Society announced that Pleasant Valley Sanctuary had become the newest Massachusetts Audubon property. Mason informed the membership that this 259-ha (640-acre) Berkshire sanctuary, in conjunction with the Berkshire Museum, would continue its extensive education program, nature workshops, and popular natural history day camp.

Two other small sanctuaries were added to Massachusetts Audubon Society properties at mid-century. The 16-ha (40-acre) Cook's Canyon preserve in Barre was given to the Society by Mr. and Mrs. George W. Cook in 1948. Almost immediately, conservation classes in the surrounding towns of Barre, Petersham, and Ware were coordinated from this center. The 1.6-ha (4-acre) "Nahant Thicket" Maple Swamp Wildlife Sanctuary was also acquired at this time through the generosity of Richard D. Fay and Henry H. Perry. Although small, the coastal location of this wooded plot made it an important feeding and resting locale for migrant land birds. Ludlow Griscom, among others, developed an impressive list of the birds of "Nahant Thicket" that is still being added to today.

Ipswich River Wildlife Sanctuary and Annie H. Brown Reservation.—In February of 1951, President Walcott announced the acquisition of the Proctor Estate at Topsfield on the Ipswich River. The Society purchased this 809-ha (2000-acre) property from the estate of Thomas Emerson Proctor for \$50,000 (Walcott 1951). Originally called the Proctor Wildlife Sanctuary and Annie H. Brown Reservation, the sanctuary soon adopted the formal name of Ipswich River Wildlife Sanctuary and Annie H. Brown Reservation. The nod to Annie Brown resulted from a reinvestment of the monies originally received from the bequest of Brown. Ultimately, this newest refuge was referred to simply

as the Ipswich River Sanctuary. Elmer P. Foye became the sanctuary's first director. Within the year, youth groups, garden clubs, botanists, and bird watchers began making regular use of Ipswich River. Just 40 km (25 miles) north of Boston, the property complemented the Moose Hill Sanctuary to the south.

Cotuit, Marblehead, and Milton.—An article in the June 1952 *Bulletin* stated, "The sanctuary properties of the Massachusetts Audubon Society, like Topsy, have 'jest grewed' . . . and grew they did" (Anonymous 1952b). In the mid-1950s four more properties were added. In April of 1953, 6.5-ha (16-acre) Sampson's Island off Cotuit was gifted to the Society by Harry L. Bailey. This important breeding ground for terns, which had been leased to the Society in the early 1940s, became the organization's ninth sanctuary. Another relatively small but important property was accepted by the Society in 1953. The Marblehead Neck Wildlife Sanctuary was preserved thanks to the community efforts led largely by Mrs. David Searle and Walter M. McKim of the Marblehead Neck Improvement Society. Local residents, seeing the rapid development on the "Neck," purchased the land and raised an endowment before turning the property over to the Society. This sanctuary preserved an important resting and feeding area for migrant song birds. In 1955, Rocky Knoll, a nineteenth century house and woodland tract in Milton, was given to the Society by the trustees of the Henry B. Martin Fund and Eleanor P. Martin. The property soon became the educational headquarters of the Society, providing a library, offices, and classrooms for the growing program.

Hatheway Estate and Drumlin Farm.—The jewels of property acquisitions in the 1950s were the Louise Ayer Hatheway Estate and Drumlin Farm received by the Society in 1956. This 72-ha (177-acre) property in Lincoln would ultimately have an important role in significant changes in the Massachusetts Audubon Society. As Marjory Sanger stated (1956), the property was unequalled "in the extent of its scope and possibilities." A working farm, orchards, pond, mansion, and various outbuildings would open new vistas to the Society. Within two years, Lincoln would become the new headquarters for the Society and important administrative changes would signal a new era in the history of Massachusetts Audubon.

Wachusett Meadow.—In late 1956, yet another property was acquired. The Wachusett Meadow Sanctuary in Princeton was the gift of Mr. and Mrs. C. T. Crocker III and comprised an inn, residence, and 256 ha (633 acres) of mixed woodlands. Like the Society's other sanctuaries, Wachusett Meadow soon took its place in the statewide system of educational and conservation programs being offered by Massachusetts Audubon.

Conclusions.—The Massachusetts Audubon Society was a seminal force in the national conservation movement at the end of the nineteenth and early twentieth centuries. In 1996 the Society celebrated a century of education and conservation (Leahy et al. 1996). It continues to be a force, at least in Massachusetts, to this day.

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LITERATURE CITED

- Allen, F. H. undated. History [of] the Massachusetts Audubon Society. Unpublished manuscript, Archives of the Massachusetts Historical Society, Boston, Massachusetts. [The latest date mentioned in the manuscript is 1957.]
- Allen, F. H. 1926. The Federation of the Bird Clubs of New England. *Bulletin of the Massachusetts Audubon Society* 10(1):15.

- Allen, F. H. 1934. The Federation of the Bird Clubs of New England. A record of its first ten years. Federation of the Bird Clubs of New England, Boston.
- Allen, J. A. 1876. On the decrease of birds in the United States. *Penn Monthly*, 7(December):931-944.
- Allen, J. A. 1886. The present wholesale destruction of bird-life in the United States. *Science* 7:191-195.
- [Allen, J. A.] 1886. Protection of birds by legislation. *Forest and Stream* 27(16):304.
- Anonymous. 1884. Second meeting of the American Ornithologists' Union. *Auk* 1:369-379.
- Anonymous. 1917. The Annual Mass Meeting. *Bulletin of the Massachusetts Audubon Society* 1(3):10-11.
- Anonymous. 1921. Twenty-fifth anniversary. *Bulletin of the Massachusetts Audubon Society* 4(8):2-3.
- Anonymous. 1944. Conservation through education: a major activity of the Massachusetts Audubon Society. *Bulletin of the Massachusetts Audubon Society* 28:159-163.
- Anonymous. 1952a. Thumbnail sketches of our directors: Robert Walcott. *Bulletin of the Massachusetts Audubon Society* 36:159-160.
- Anonymous. 1952b. New name adopted for sanctuary. *Bulletin of the Massachusetts Audubon Society* 36:240-241.
- Austin, O. L., Sr. 1941. Status of Cape Cod terns in 1941 from the standpoint of conservation. *Bulletin of the Massachusetts Audubon Society* 25:175-182.
- Bagg, A. C. 1938. Will Massachusetts lose one of its finest wild life sanctuaries? A plea for Arcadia. *Bulletin of the Massachusetts Audubon Society* 22(4):2-5.
- Bagg, A. C., and S. A. Eliot, Jr. 1937. Birds of the Connecticut Valley in Massachusetts. Hampshire Bookshop, Northampton, Massachusetts.
- Balch, F. N. 1945. Ornithologists alive! IV. Francis H. Allen. *Bulletin of the Massachusetts Audubon Society* 29:89-92.
- Barrow, M. V., Jr. 1998. A passion for birds. Princeton University Press, Princeton, New Jersey.
- Batchelder, C. F. 1937. An account of the Nuttall Ornithological Club 1873 to 1919. *Memoirs of the Nuttall Ornithological Club*, no. 8, Cambridge, Massachusetts.
- Braun, M. 1929. A Berkshire County bird sanctuary. *Bulletin of the Massachusetts Audubon Society* 13(7):9-10.
- Braun, M. 1935. A Pennsylvania sanctuary for birds of prey. *Bulletin of the Massachusetts Audubon Society* 18(1):5-9.
- Buchheister, C. W. 1938. Report of the secretary of the Massachusetts Audubon Society. *Bulletin of the Massachusetts Audubon Society* 22(1):3-4.
- Coues, E. 1874. Field ornithology. Comprising a manual of instruction for procuring, preparing and preserving birds, and a check list of North American birds. Naturalists' Agency, Salem, Massachusetts.
- Crawford, M. C. 1930. The Hemenway family. Famous families of Massachusetts, Volume I. Little, Brown, and Company, Boston.
- Davis, W. E., Jr. 1987. History of the Nuttall Ornithological Club 1873-1986. *Memoirs of the Nuttall Ornithological Club*, no. 11, Cambridge, Massachusetts.

- Davis, W. E., Jr. 1994. *Dean of the birdwatchers, a biography of Ludlow Griscom*. Smithsonian Institution Press, Washington, D.C.
- Directors (MAS). 1917. Report of the directors. *Bulletin of the Massachusetts Audubon Society* 1(1):7-14.
- Directors (MAS). 1921. Report of the directors. *Bulletin of the Massachusetts Audubon Society* 5(1):3-8.
- Directors (MAS). 1957. Our honored past president. *Bulletin of the Massachusetts Audubon Society* 41:83-84, 90.
- Dutcher, W. 1897. Report of the A.O.U. Committee on Protection of North American Birds. *Auk* 14:21-32.
- Dutcher, W. 1905. History of the Audubon movement. *Bird-Lore* 7:43-57.
- Eliot, S. A., Jr. 1932. Arcadia Sanctuary newly established at Northampton. *Bulletin of the Massachusetts Audubon Society* 16(8):9-10.
- Faxton, W., and R. Hoffmann. 1900. *The birds of Berkshire County, Massachusetts*. no publisher, no location.
- Forbush, E. H. 1907. Useful birds and their protection. *Massachusetts State Board of Agriculture, Boston*.
- Forbush, E. H. 1912. *A history of the game birds, wild-fowl, and shore birds of Massachusetts and adjacent states*. Massachusetts State Board of Agriculture, Boston.
- Forbush, E. H. 1924. Help the migratory game birds. *Bulletin of the Massachusetts Audubon Society* 8(4):3-4.
- Forbush, E. H. 1925-1929. *Birds of Massachusetts and other New England states*. Part I (1925); Part II (1927); Part III (1929). Commonwealth of Massachusetts, Norwood.
- Grinnell, G. B. 1886. The Audubon Society. *Forest and Stream* 26(3):41.
- Griscom, L. 1938a. Decrease and increase in Massachusetts birds. *Bulletin of the Massachusetts Audubon Society* 22(3):10-14.
- Griscom, L. 1938b. A phenomenal spring migration. *Bulletin of the Massachusetts Audubon Society* 22(5):1-3.
- Graham, F., Jr. 1990. *The Audubon ark: a history of the National Audubon Society*. Alfred A. Knopf, New York.
- Hagar, J. A. 1945. *Parker River Wildlife Refuge: the case for a revision of plans*. Massachusetts Department of Conservation, no location.
- Harrington, A. B. 1923. More bird banding notes. *Bulletin of the Massachusetts Audubon Society* 7(2):13.
- Hemenway, Mrs. A. [H. L.], and M. B. Hall. Undated. *The founding of the Massachusetts Audubon Society*. Typed manuscript in the Records of the Massachusetts Audubon Society, Massachusetts Historical Society, Boston.
- Hendricks, B. 1948. Berkshire birds. *Bulletin of the Massachusetts Audubon Society* 32:291-298.
- Higbee, H. G. 1918. Birds of the Moose Hill Sanctuary. *Bulletin of the Massachusetts Audubon Society* 2(5):8-12.
- Hoffmann, R. 1904. *A guide to the birds of New England and eastern New York*. Houghton Mifflin, Boston.
- Kilham, L. 1938. Nesting eider ducks in Penobscot Bay. *Bulletin of the Massachusetts Audubon Society* 22(7):5-8.
- Kimball, J. E. 1906. State reports: Massachusetts. *Bird-Lore* 8:260-261.
- Leahy, C., J. H. Mitchell, and T. Conuel. 1996. *The nature of Massachusetts*. Addison-Wesley, Reading, Massachusetts.

- Malone, D. (ed.). 1934. Minot, Charles Sedgwick. Dictionary of American Biography, Mills-Oglesby, Volume 8. Charles Scribner's Sons, New York.
- Mason, C. R. 1942. Keep 'em flying! Bulletin of the Massachusetts Audubon Society 26:14-17.
- May, J. B. 1929. Edward Howe Forbush, friend of the birds. Pp. xvii-xlvi in E. H. Forbush, Birds of Massachusetts and Other New England States, Part III, Commonwealth of Massachusetts, Norwood.
- Merriam, F. A. 1889. Birds through an opera glass. Riverside Press, Boston.
- Miller, S. M. 1993. John Muir, life and work. University of New Mexico Press, Albuquerque.
- Morgan, A. undated. A history of Massachusetts Audubon Society. Chapter 1: Introduction. Unpublished manuscript, Records of the Massachusetts Audubon Society, Archives of the Massachusetts Historical Society, Boston.
- Orr, O. H., Jr. 1992. Saving American birds: T. Gilbert Pearson and the founding of the Audubon movement. University Press of Florida, Gainesville.
- Packard, W. 1921. The story of the Audubon Society. Bulletin of the Massachusetts Audubon Society 5(8):2-9.
- Packard, W. 1926. Two-weeks bird camp, Winthrop Packard leader. Bulletin of the Massachusetts Audubon Society 10(3):7-10.
- Packard, W. 1936. Te salutamus. Bulletin of the Massachusetts Audubon Society 20(6):3-4.
- Palmer, R. S. 1938. Penobscot Bay terns. Bulletin of the Massachusetts Audubon Society 22(2):10-15.
- Palmer, T. S. 1943. George Henry Mackay [obituary]. Auk 60:314-315.
- Pearson, T. G. 1912. Some Audubon workers. IV. George Bird Grinnell. Bird-Lore 14:77-80.
- Pearson, T. G. 1933. Fifty years of bird protection in the United States. Pp. 199-213 in F. M. Chapman and T. S. Palmer, eds., Fifty Years' Progress in American Ornithology. American Ornithologists' Union, Lancaster, Pennsylvania.
- Peterson, R. T. 1934. A field guide to the birds. Houghton Mifflin, Boston.
- Peterson, R. T. 1941. Billions of birds. Bulletin of the Massachusetts Audubon Society 25:149-154.
- Renehan, E. J., Jr. 1992. John Burroughs, an American naturalist. Chelsea Green Publishing Company, Post Mills, Vermont.
- Richards, H. E. 1901a. Reports of the societies: The Massachusetts Society. Bird-Lore 3:219.
- Richards, H. E. 1901b. Report of societies: Massachusetts Society. Bird-Lore 3:81-82.
- Sanger, M. B. 1956. Drumlin Farm: unique gift to conservation. Bulletin of the Massachusetts Audubon Society 36:240-241.
- Talbot, L. R. 1930. Report of the educational field agent. Bulletin of the Massachusetts Audubon Society 14(1):4-5.
- Walcott, R. 1942. The president's page. Bulletin of the Massachusetts Audubon Society 26:186-187.
- Walcott, R. 1951. The president's page [purchase of the Proctor Estate]. Bulletin of the Massachusetts Audubon Society 35:50.
- Walcott, R. 1953. The president's page [obituary of Francis H. Allen]. Bulletin of the Massachusetts Audubon Society 37:374-376.

- Walton, R. K. 1984. Birds of the Sudbury River Valley –an historical perspective. Massachusetts Audubon Society, Lincoln.
- Welker, R. H. 1955. Birds and men: American birds in science, art, literature, and conservation. Harvard University Press, Cambridge, Massachusetts.
- Wright, M. O., and E. Coues. 1898. Citizen bird: scenes from bird life in plain English for beginners. Macmillan, New York.

Ornithology and the Natural History Museum of Los Angeles County

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ABSTRACT.—The Natural History Museum of Los Angeles County was established in 1910 at a time of rapid development of science museums and universities in the western United States. Formed in part through the efforts of the Southern Division of the Cooper Ornithological Club, the museum opened to the public in 1913 in the oldest wing of its current building in Exposition Park. Through the efforts of curators and a series of ornithologist-directors, including Frank S. Daggett, George Willett, Kenneth E. Stager, Jean Delacour, and Herbert Friedmann, the collections grew in size and geographical scope through the institution's first 60 years. The collections are now global in scope, with 39,000 specimens from North America, 34,600 from South America, and 25,900 from Africa, as well as excellent seabird collections from the Pacific Ocean. Avian paleontology, involving foremost the study and interpretation of the vast bird remains from the Rancho La Brea asphalt deposit fauna, has been a hallmark of bird studies at the Museum since its inception; much of the pioneering work on these collections was done by Hildegard Howard; such work continues today. Under the curatorship of Ralph W. Schreiber in the late 1970s and 1980s the collections diversified through the rapid growth of skeleton, spirit, and tissue collections, and the entire collection database was captured electronically. Public exhibits about birds, long a trademark of the institution, culminated in the opening of a major, interactive Hall of Birds in 1991. Staff downsizing and decreased institutional support for research and collections programs currently plague the Museum, as at many other institutions, but the ornithology program perseveres.

The Natural History Museum of Los Angeles County is the largest free-standing natural history museum in western North America, holding in public trust some 33 million specimens and objects in numerous disciplines of zoology, geology, anthropology, and history. Approaching its centennial year, the museum now qualifies as a venerable old cultural

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landmark by southern California standards, and it attracts some 750,000 visitors per year to its main Exposition Park facility and two satellite museums (George C. Page Museum of La Brea Discoveries and the William S. Hart Ranch Historical Museum). The discipline of ornithology figured prominently in the establishment of the Museum, and it has continued to be prominent throughout the institution's history. Although the Museum has never served as a leading center for systematics research in ornithology and has no formal connection with graduate research programs, the Natural History Museum of Los Angeles County has amassed internationally important collections, has continuously exhibited the world of birds to the public for most of its history, and has been staffed or directed by prominent ornithologists and avian paleontologists from Frank S. Daggett and George Willett to Hildegarde Howard, Kenneth E. Stager, Jean Delacour, Herbert Friedmann and, more recently, Ralph W. Schreiber and Kenneth E. Campbell.

A note about the name of the institution.— Like many institutions, the “Los Angeles County Museum” has seen reinvention and reorganization of governance several times over the course of its history. The institution was originally called the Los Angeles County Museum of History, Science and Art. This name was usually informally shortened to Los Angeles County Museum, and thus the museum's ornithological collections have long been known in the systematics community by the abbreviation “LACM” (and that shorthand is used frequently in this chapter). The art component of the museum fledged in 1960 to its own building in Hancock Park and became a separate county department, the Los Angeles County Museum of Art. The Exposition Park facility became known as the Los Angeles County Museum of Natural History. For various reasons, this name evolved in the latter decades of the 20th Century to the “Natural History Museum of Los Angeles County.”

THE MUSEUM'S FOUNDING AND ORNITHOLOGICAL ROOTS

The Natural History Museum of Los Angeles County was born as the “Los Angeles Museum of History, Science and Art” in February of 1910, when the County of Los Angeles entered into a contract with the Historical Society of Southern California, the Fine Arts League, the

Southern California Academy of Sciences, and the Southern Division of the Cooper Ornithological Club. Los Angeles, still something of an outpost, yet rapidly growing on a trajectory that would eventually make it the second largest urban region in the United States, was hungry for a grand public statement and the convergence of these various entities marked the opportune moment to create such an institution.

The new museum was to be located south of the Los Angeles civic center and financial district on land set aside in the 1870s as "Agricultural Park." Outside the limits of the City of Los Angeles at the time, and therefore somewhat forgotten, the primary drivers of the area's economy included a racetrack and a string of brothels, bars, and gambling outlets. The University of Southern California (USC) was established next to the park in 1880, and some of the wealthier families in Los Angeles began to move into the area. Calls for cleaning up the area naturally increased. Judge and USC professor William M. Bowen, credited for founding Exposition Park, reported in the late 1890s that "This was a plague spot infecting the entire community and destined, if left alone, to bring us all into ill repute" (Sibley 1978:5). In 1909 the property's owner, California's Sixth District Agricultural Association, negotiated with the city and county of Los Angeles and the State of California to transform Agricultural Park into a cultural center. The state would build an armory building and an exposition building which have now become the state's California Science Center. The County of Los Angeles would build a history, science and art museum, and the City of Los Angeles agreed to maintain the grounds.

Groundbreaking in the former Agricultural Park on the southern fringe of the developing city of Los Angeles took place in December 1910, and the museum's original structure (Figure 1) was completed by the end of 1912. A gala celebration marked the opening of the Museum in what was now christened Exposition Park on 6 November 1913. With great fanfare, this celebration concluded a weekend of festivities, the first day of which saw the commemoration of the arrival of Owens Valley water through William Mulholland's aqueduct at the north end of the San Fernando Valley (a vial of that water remains to this day in the Museum's history collections). The Museum's opening gala included a nearly 5-km (3-mile) parade with over 100,000 people in attendance. Sibley (1978) provides additional detail on the early history of the museum, and Garrett (1990) gives an abbreviated history of ornithology at the museum.



Figure 1. The original building of the Los Angeles County Museum of History, Science and Art, shown here in April 1916. Courtesy of the Natural History Museum of Los Angeles County.

Frank S. Daggett and the beginning.— From the outset, the museum had close ties to the Cooper Ornithological Club's Southern Division. Howard Robertson (1877-1956), secretary of the Southern Division of the Cooper Club, was the Cooper Club's representative to the new museum's board of governors, a position he held from the museum's inception until his death in 1956. This Board of Governors, greatly influenced by Robertson, appointed Frank S. Daggett (also of the Cooper Club) as the first Director of the new museum in 1911 (Figure 2). The minutes of the Southern Division for January 1912 read: "Mr. Daggett has already assumed control and the Cooper Club is congratulating itself that one of its members has been available for this position" (Law 1912). In May 1912 the Cooper Club held its Southern Division meeting at the new Museum of History, Science, and Art. The meeting "adjourned to spend a very pleasant hour under the direction of Mr. Daggett inspecting the beautiful buildings of the museum and the very creditable work accomplished in the short time its energetic director has been at work. Unqualified commendation was expressed by all;" this is taken from the minutes of the May 1912 meeting, written by Loyce Miller, long-time ornithologist and paleontologist at the University of California at Los Angeles (Miller 1912).



Figure 2. The recent opening of the Museum occasioned a visit from President William Howard Taft (second from left) on 15 September 1915; museum director, ornithologist Frank S. Daggett, is second from right. Courtesy of the Natural History Museum of Los Angeles County.

THE EARLY ORNITHOLOGISTS AND THE BEGINNINGS OF THE COLLECTIONS

Frank S. Daggett (1855-1920) not only became the museum's first director, but he also added his collection of about 8000 bird specimens (primarily from western North America, with over 5000 collected by Daggett himself) as the core ornithological collection for the new institution. Daggett and Howard Robertson collected a nest with eggs of the "Willow" Goldfinch (*Carduelis tristis salicamans*) along the San Gabriel River in 1911, which became the very first official accession to the new museum. A midwesterner involved in the grain business, Daggett had a passion for natural history and collecting (primarily birds and insects), and he became closely involved with the Cooper

Ornithological Club's Southern Division after moving to Pasadena, California in the early 1890s. More details of his life are given by Swarth (1920). Daggett held the position of director from 1911 until his death in April 1920, after which Howard Robertson served as acting director until William A. Bryan was hired in 1921.

In 1913 Harry S. Swarth (1878-1935) was persuaded by Daggett to accept a position as assistant director of the new museum. Swarth had previously been associated with the Field Museum in Chicago and, since 1908, with the nascent Museum of Vertebrate Zoology (MVZ) in Berkeley. Swarth left after a three-year tenure at LACM, evidently discouraged at the lack of opportunity for field collecting and research, to return to the MVZ, after which he became curator of birds at the California Academy of Sciences in San Francisco from 1927 until his death (Linsdale 1936).

The first staff ornithologist at the new museum was Luther E. Wyman (1860-1928), who served from 1920 until 1927. Frank Daggett had brought Wyman to Los Angeles from Chicago to work on the extensive collections of Rancho La Brea Pleistocene bird fossils, which ultimately became what could be considered the museum's signature collection. Wyman, who was later appointed assistant curator, was closely associated with the Cooper Club's Southern Division, having served as secretary and as president from 1924 to 1926. In addition to Wyman's work on avian material from Rancho La Brea, he served as the museum's photographer. Los Angeles, dominated by the automobile since the 1940s, once had a credible public rail system, and Wyman availed himself of a line that went from the Exposition Park area to the beaches near what is now Los Angeles International Airport to collect a large series of gull specimens that bear the locality name "Hyperion." The southern subspecies of the Western Gull (*Larus occidentalis wymani*) was named in his honor by Donald R. Dickey and A. J. van Rossem (Dickey and van Rossem 1925).

George Willett (1879-1945; Figure 3) served as a policeman in the Los Angeles Police Department from 1903 to 1912 (including a stint as patrolman in Chinatown), as well as in Alaska. He was hired in 1927 as an assistant ornithologist under Wyman, and served as curator of birds from 1928 until shortly before his death in August 1945. Willett's own substantial collection of over 4000 specimens, which was built up before and during his LACM tenure, was incorporated into the museum's growing collections. Among the earliest important collecting



Figure 3. George Willett (right) in the field with preparator George Cantwell, ca. 1940. Courtesy of the Natural History Museum of Los Angeles County.

expeditions mounted by the young institution were trips to the California Channel Islands (Wyman in 1920 and Willett in 1939) and to Mexico and Central America (Willett in 1938); Willett also made important collections in southern and southeastern Alaska in the early 1920s. Throughout his career, Willett also collected and studied mollusks. George Cantwell served as assistant ornithologist, preparator, and taxidermist under Willett from 1929 to 1939.

Willett was keenly interested in cataloguing the avifauna of southern California. He authored one distributional summary of the region before he came to the museum (Willett 1912), and later a thorough revision (Willett 1933). Also during his curatorship Willett produced three general accounts of the avifauna of the Los Angeles region for a lay audience (Willett 1942, 1943a,b). This was the beginning of what was to become a long history of the museum as a center for maintaining bird records in the Los Angeles area and providing education to the public about the local avifauna.

Important collections built or purchased through these early years of the institution, besides those brought or made by staff ornithologists,

included 1500 specimens from J. Hornung and 1550 Central American specimens from Austin Smith.

The directorship of ornithologists.— Frank Daggett, the museum's first director, was not the last ornithologist to serve in that position. William Alanson Bryan (1875-1941) was the second director to serve the museum, and he was also an ornithologist. He succeeded Daggett in 1921 and was director until 1939, the longest period of service of any of the museum's directors. Bryan had served for one year as assistant curator of ornithology at the Field Museum in Chicago, and also as a curator of ethnology and natural history at the Bishop Museum in Honolulu and professor at the College (now University) of Hawaii. His career included much ornithological work in the Hawaiian Islands, as well as unsuccessful bids for the governorships of Hawaii and California. Bryan steered the museum through the Great Depression and presided over great expansions of the exhibits and collections. Small, but important, collections of Hawaiian birds made by Bryan exist today in the LACM collections.

Ornithologists directed LACM for 45 of the first 60 years of its history. Jean Delacour was director from 1952 to 1960, and Herbert Friedmann (1900-1987) from 1960 to 1970. Besides Robertson, other ornithologists or bird collectors serving on the museum's board of governors over the years included J. R. Pemberton, C. V. Duff, Ed N. Harrison, and William J. Sheffler.

RANCHO LA BREA, AVIAN PALEONTOLOGY, AND HILDEGARDE HOWARD

The rich collection of Pleistocene fossils from the asphalt deposits at Rancho La Brea (Figure 4) has been a major source of research material at the Natural History Museum of Los Angeles County since the institution's founding. Law (1912:51) writes in the Cooper Club minutes that "Mr. Daggett has already secured valuable material in the fossils taken from the Rancho la Brea beds, and this feature alone will be enough to make the Museum a great one." The Rancho La Brea deposits are in Hancock Park, only ca. 8 km (five miles) northwest of Exposition Park and now the home of an LACM satellite museum dedicated to the



Figure 4. One of the early excavation pits at the Rancho La Brea asphalt deposits (or “tar pits”). Through these excavations, still ongoing, the Museum has amassed one of the premier avifaunal records of the late Pleistocene of North America. Courtesy of the Natural History Museum of Los Angeles County.

“tar pits” and Pleistocene studies as well as the Los Angeles County Museum of Art.

Hildegarde Howard (1901-1998) had an association with the museum that began in 1921 and continued to include parts of eight decades. Campbell (1980, 2000) provided more details about this extraordinary woman’s career, and much of what follows is taken from those sources. After working part-time with the Rancho La Brea fossils at the museum in 1921, and guided by Loye Miller, Chester Stock, and Joseph Grinnell, Howard received her undergraduate and masters degrees (in 1926 on the California turkey of Rancho La Brea) and Ph.D. (in 1928 on the avifauna of the Emeryville Shellmound) at the University of California at Berkeley. She returned to the museum as a full-time employee in 1929 and shortly thereafter married Henry A. Wylde, chief of exhibits at the museum. Howard was ultimately appointed as a curator of vertebrate paleontology in 1938, after having served in that function for ten years;

she was probably the first museum scientist anywhere to hold a curatorship with a specialty as an avian paleontologist (Campbell 1980). She was appointed chief curator of science at the museum in 1951, a position she held until her retirement in 1961. She oversaw the preparation of the museum's first skeletal mounts of the extinct birds of Rancho La Brea; many of these dramatically posed skeletons are currently on exhibit in the George C. Page Museum.

In 1953, Howard followed Florence Merriam Bailey and Margaret Morse Nice as the third woman to receive the distinguished Brewster Medal of the American Ornithologists' Union, and after her retirement she received a Guggenheim fellowship in support of her continued research in paleornithology. Her dedication and service to LACM were recognized in 1977, when the Hildegard Howard Hall of Cenozoic Life was dedicated in the Museum's Exposition Park facilities and later in the publication of a volume of paleontological research papers in a festschrift convened in her honor (Campbell 1980). Howard continued to work at the museum for thirty years after her "retirement," publishing her last paper in 1992.

AN ERA OF GREAT EXPANSION OF COLLECTIONS

Ken Stager era.—Kenneth E. Stager (1915-2009; Figure 5) had been a student under George Willett, and he began his association with the museum as a student worker in 1939, assuming in part some of the work performed by George Cantwell, who had recently departed the Museum. Stager was hired full time in May 1942 as a curatorial assistant under Willett. World War II had the Museum's staff in a bit of flux, and Stager went off to war, serving with Merrill's Marauders in Burma (now Myanmar). During that period he managed to collect 139 bird skins in June-July 1944 and March to October 1945; among these was a Silver Pheasant (*Lophura nycthemera*) which he particularly prized. George Willett died while Stager was in Burma; a memoriam to Willett was written by Howard (1946). Stager returned to Los Angeles in 1946, and was immediately appointed curator of birds and mammals. During portions of Stager's tenure he also oversaw the mammalogy department and was, for a period, curator of exhibits.

Stager investigated the role of olfaction in food location by the Turkey Vulture (*Cathartes aura*) for his doctorate at the University of



Figure 5. Kenneth E. Stager packing bird specimens during the museum's Barranca del Cobre, Mexico, expedition in 1950. Courtesy of the Natural History Museum of Los Angeles County.

Southern California; this work was published through the museum's Contributions in Science series (Stager 1964). His greatest and most enduring contribution to the museum and to ornithology was the substantial acceleration of expeditionary collecting work under his curatorial supervision (and the support of directors Delacour and Friedmann). Major, privately-sponsored expeditions included the following (with principal ornithologist or principal resulting publication in parentheses):

- 1950 Sheffler Expedition to the Barranca del Cobre, Mexico (Stager)
- 1954 Davidson Expedition to Australia (Stager)
- 1954 Islas Tres Marias, Mexico (Stager)
- 1956 Machris Expedition to Brazil (Delacour 1957, Stager 1961)
- 1957 Bolivia (Stephen C. Bromley)
- 1958 Clipperton Island (Stager)
- 1959 Machris Expedition to India (Stager)

- 1960 Machris Expedition to Chad (Friedmann 1962)
- 1963 Knudsen-Machris Expedition to Kenya, Uganda (Friedmann 1966)
- 1964 Cheney Expedition to Tanzania (Friedmann and Stager 1964)
- 1966 Cheney Expedition to Samburu District, Kenya (Friedmann and Stager 1967)
- 1968 Avil Expedition to Mt. Nyiru, Kenya (Friedmann and Stager 1969)
- 1972 Taylor Expedition to South West Africa (Friedmann and Northern 1975)
- 1975 Machris Expedition to Cocos and Galapagos (Stager)
- 1976 Lathrop Expedition to Central African Republic (Friedmann 1978)

In addition, important National Science Foundation-sponsored expeditions to various lowland forests of Uganda were conducted in 1967 and 1968-1969 (Friedmann and Williams 1969, 1970, 1971). These and many of the other expeditions concentrated on forested regions that were highly threatened by logging and other environmental perturbations, and the specimens resulting from these efforts are of great value today as they document highly impacted avifaunas in areas such as the Budongo and Impenetrable forests of Uganda, the Sokoke forest of Kenya, and the Atlantic coastal forests of Brazil. Also, during this period a number of large collections were purchased and professional collectors in Africa (J. Ithia, J. N. and R. Kyongo, J. G. and A. Williams) and South America (H. Berla, E. Dente, A. Kovacs, J. L. Lima, and A., M., and C. Olalla) provided skins to LACM. Notable among these were over 2200 sunbird (Nectariniidae) specimens from John G. Williams. Over 12,000 skins, a large portion of the William Partridge collection from Misiones, Argentina, were purchased by the museum in 1963.

Stephen C. Bromley began an affiliation with the Natural History Museum of Los Angeles County when in high school. Later, as he developed proficiency in collecting and preparing bird specimens, he joined Stager in the field in Bolivia and was the sole ornithologist on collecting trips to Chad and Venezuela. Bromley went on to a career as a professor of biology at Michigan State University.

Stager's trip to Clipperton Island in August 1958 was notable for his successful efforts to eliminate the feral pigs (*Sus scrofa*) that had

devastated the small atoll. The pigs weren't deposited into the LACM collections, but Stager collected a specimen of *Coccyzus melacoryphus* there, the first to be taken in North America.

During Stager's curatorship, James R. Northern served as curatorial assistant in ornithology from 1956 until he left to manage the Donald R. Dickey Collection of Birds and Mammals at the University of California at Los Angeles in 1980. During the Stager/Northern period the art component of the Natural History Museum moved to its own site in Hancock Park and an independent governance, and the ornithological collections were soon moved to more ample space in the north part of the museum's western wing (a space with ample indirect, north lighting formerly occupied by sculptures and other art exhibits).

Two more director-ornithologists: Jean Delacour and Herbert Friedmann.—Jean Delacour (1890-1985) was appointed director in February of 1952. After some tumultuous post-war years at the institution under the directorship of James H. Breasted, Jr., who had resigned the previous year, Howard Robertson of the Board of Governors wanted somebody of stature who would "calm things down." Delacour was identified as that person and was hired as director, a position he held until 1960. Delacour's tremendous body of ornithological work (summarized by Mayr 1986 and recognized by the American Ornithologists' Union's Elliott Coues Award in 1977) preceded his appointment at LACM, although during his tenure he oversaw important expansions of the collections and maintained a close relationship with the avicultural community that he continued both in Los Angeles and at his Clères estate in France after his retirement.

Herbert Friedmann (1900-1987) of the Smithsonian Institution was asked to suggest a replacement for Delacour upon the latter's retirement. Friedmann admitted that if he were younger he would consider the position. He was hired in 1961. It was early under Friedmann's directorship that the art component of the institution completed its departure with the establishment of the Los Angeles County Museum of Art in Hancock Park, adjacent to the Rancho La Brea "Tar Pits" (and, ultimately, a neighbor to the George C. Page Museum of La Brea Discoveries, a satellite of the Natural History Museum and part of its Vertebrate Studies Division which opened in 1977). This separation was a matter of some disappointment to Friedmann, who, in the latter part of

his career, passionately researched the symbolic importance of depictions of birds and other animals in European religious art (e.g., Friedmann 1980). However, the departure of the art museum staff allowed Friedmann to double the size of the science staff, and his directorship saw an expansion of systematics collections at the Museum (for example, with the establishment of a Section of Herpetology) and the continuation of large-scale collecting expeditions. A celebration of Friedmann's career was held at the museum in 1981 (Figure 6); a memoriam to him appears in *The Auk* (Rothstein et al. 1988).

THE MODERN (POST-1975) ERA

Ralph Schreiber and modern ornithological research and collections management.—Ken Stager officially retired in January 1976, even though he continued to work actively in the field and in the LACM collections (principally on bats) until a stroke suffered in 2001 made it difficult for him to visit the museum with any regularity. Ralph W. Schreiber (1942-1988) began his tenure as curator of birds in 1976, having completed a doctorate at University of South Florida in 1974 on the behavior and reproduction of the Brown Pelican (*Pelecanus occidentalis*) under Glen E. Woolfenden. His participation in the Pacific Ocean Biological Survey Program of the Smithsonian Institution from 1966 to 1969, following dissertation work on the Brown Pelican, focused his research trajectory on tropical seabirds.

During his years at LACM, Ralph Schreiber (along with his wife Elizabeth Anne or “B.A.”, a research associate at the Museum) conducted annual research on tropical seabirds in the central Pacific Ocean, with most work performed on Christmas Island (Kiritimati) in Kiribati and on Johnston Atoll south of the Hawaiian Islands. The Schreibers had amassed considerable data on the population biology of nesting sulids, tropicbirds, tubenoses, and terns on these islands; thus, the serendipitous occurrence of one of the largest El Niño-Southern Oscillation events in recorded history in 1982-1983 allowed an extensive and well-publicized analysis of the link between such oceanographic events and seabird reproductive failures (Schreiber and Schreiber 1984).

Despite Schreiber's occasional pronouncements that no “real bird” weighed under a kilogram, nor was smaller than a breadbox, he grew



Figure 6. Los Angeles area ornithologists, including Museum research associates and staff, convene at the museum for a celebration for Herbert Friedmann on 3 April 1981. From left to right, Nicholas E. Collias, Thomas R. Howell, Lloyd F. Kiff, Charles T. Collins, Jean Delacour (seated), George A. Bartholomew, Ralph W. Schreiber (curator of ornithology), Herbert Friedmann, and Elsie Collias. Courtesy of the Natural History Museum of Los Angeles County.

the collections in many ways, including birds large and small. During Schreiber's tenure there was an emphasis on anatomical specimens (especially flat skin/skeleton combinations, but also spirit specimens) as part of the systematics collections. Osteological collections prior to this time had largely been built as comparative material for the vertebrate paleontology division, and often were collections of elements or other non-associated skeletal material. Under Schreiber's curatorship, and with the guidance of vertebrate paleontology curator Kenneth E. Campbell, the skeleton collection grew rapidly and large series of skeletons of many species were organized, making the osteological collec-

tions a goldmine for systematics research as well as for comparative material in paleontological and zooarchaeological research.

During Schreiber's tenure, Sarah B. George, curator of mammals, initiated the routine collection of frozen tissues from field-collected specimens in 1985, and the ornithology collections immediately embraced this addition to the collection repertoire. Today LACM houses some 3000 avian tissue samples. Somewhat ironically, modern molecular techniques have made samples (from skin or toe pads) from existing study skins of species rarely collected in recent decades far more desirable for molecular research than most of the more recently-collected frozen tissue specimens.

A major accomplishment during Ralph Schreiber's tenure was the complete computerization of the collection catalogue. With data originally captured on what now must be viewed as a cumbersome floppy disk data entry system, the collection data were managed under "Curator" software developed at LACM by consultant malacologist Patrick LaFollette. Nearly the entire catalogue was painstakingly entered, with up to 30 data fields of information per specimen, by volunteer Margaret C. Taylor. "Maggie," whose late husband Reese Hale Taylor had been president of the Union Oil Company, had been wooed away from a volunteer position at the Los Angeles Zoo by Ken Stager, and enthusiastically embraced a variety of collection tasks. As if her labor and attention to detail were not enough, she also supported a number of collecting expeditions and donated enough Union Oil stock shares to allow the museum to purchase a mounted specimen of a Great Auk (*Pinguinus impennis*) that came up for auction in 1970 at Spink and Son of London. This specimen was likely one of the last two known Great Auks, killed in 1844 off the island of Eldey (Fuller 1999). Before Ms. Taylor's death in 1996 she donated an extensive and valuable collection of rare and old natural history and ornithological books to the Museum. A mini-celebration was held in the Ornithology Range on 28 April 1992 (Figure 7) when Maggie Taylor catalogued specimen number 100,000 (a study skin of the Blue-winged Kookaburra *Dacelo leachii* collected in Papua New Guinea 21 August 1981 by James Dale Smith). From that point onward data capture has been kept current, and as of December 2008 the database included 114,932 catalogued specimens. Table 1 gives a geographical breakdown of LACM's bird specimens, Table 2 indicates how these specimens have been prepared; Table 3 traces the growth of the collections by decade.



Figure 7. Mrs. Margaret C. (“Maggie”) Taylor catalogs LACM specimen number 100,000 (a Blue-winged Kookaburra) in April 1982. Ornithology staff includes Research Associate Sharon L. Milder (standing in front), Collections Manager Kimball L. Garrett (third from right), and (at right) Research Associate Elizabeth Anne Schreiber and Curator of Ornithology Ralph W. Schreiber. Courtesy of the Natural History Museum of Los Angeles County.

“ORNCAT,” as the computerized ornithology collection database was christened, was run on an Alpha Micro mini-mainframe computer. By today’s standards this was hardly the gold standard, but it represented one of the earliest successful efforts to completely capture data of a large ornithological collection electronically. With the increasing power of desktop computers, the catalog was moved to Microsoft Access database by 1999, and LACM joined some 30 other ornithological collections in the ORNIS (Ornithological Information System) distributed database network in 2004 to make data easily accessible via the internet.

Table 1. Representation by continent (or ocean) of bird specimens at the Natural History Museum of Los Angeles County. Excluded are several thousand aviary specimens.

North America	39,000
South America	34,600
Africa	25,900
Pacific Ocean	5550
Eurasia	2700
Australia	500
Atlantic Ocean	350
Antarctica	300
Indian Ocean	150
Arctic Ocean	10

Table 2. Representation by preparation type of bird specimens at LACM. Note the total is greater than the number of cataloged specimens (114,932 as of 31 December 2008) because of combinations such as flat skins with complete skeletons or study skins with partial skeletons.

Skins and Mounts	
Study skins	96,698
Flat skins	2007
Taxidermy mounts	1559
Wings	117
Skeletons	
Complete skeletons	12,286
Partial skeletons or miscellaneous elements	1941
Alcohol-preserved	
Alcoholic (whole)	2911
Alcoholic (partial)	31
Tissue Samples	3000

Table 3. Number of specimens collected by decade in the major regions represented in the LACM bird collections, showing peaks (underlined) occurring in decades with notable numbers of specimens.

Decade	N. America	S. America	Africa	Pac. Ocean
Beginning				
1860	2	0	0	0
1870	13	1	2	0
1880	427	2	4	7
1890	4668	0	3	3
1900	4303	6	20	136
1910	<u>6329</u>	86	49	156
1920	3748	681	33	131
1930	3680	623	36	481
1940	1723	661	930	23
1950	1817	<u>23,516</u>	2026	299
1960	1957	6523	<u>15,256</u>	496
1970	2501	1039	6892	546
1980	2869	900	181	<u>2904</u>
1990	2867	29	0	200
2000	1477	0	0	21

The management and preservation of natural science collections matured significantly during the 1980s. Time-honored specimen preservation and collection maintenance techniques had served the ornithological community well, but concerns were mounting about human health effects of some treatments (e.g., arsenic and paradichlorobenzene) and governmental safety regulations were tightening. Equally important were concerns about the potential to compromise research endeavors (including, but not limited to genetic studies, colorimetric plumage analysis, and assays for environmental contaminants) through the use of an array of (generally undocumented) preservation and fumigation techniques. The mid-1980s saw the beginning of the formalization of training in the management and preservation of natural science collections and, in 1985, the formation of the Society for the Preservation of Natural History Collections. A Bay Foundation grant and logistical support from the National Institute for the Conservation

of Cultural Property allowed LACM to host two "Collections Care Pilot Training Programs" in 1986-1987 and 1987-1988. The ornithology section played a significant role in this program as collections manager Kimball L. Garrett (along with mammalogy collections manager Linda J. Barkley) served as program coordinator. Since that time, the science of collection preservation has grown and become increasingly embedded in museum collection programs and even some university courses.

Under Ralph Schreiber, donor-sponsored collecting trips continued. Maggie Taylor sponsored bird and mammal collecting trips to Papua New Guinea and nearby islands in 1979 and 1981 (with field collecting primarily by James Dale Smith and Craig S. Hood) and to Martinique in the Lesser Antilles in 1982 (Ralph and Elizabeth Anne Schreiber). Thomas and Jane Duque and Don and Dorothy Kennedy sponsored and participated in trips to Argentina in 1981 (Schreibers) and 1989 (Kathy C. Molina and Tim A. Bovard). However, the era of cultivating individual donors and sponsors for field research and collecting faded rapidly after these expeditions, and no major privately-sponsored ornithological collecting trips have originated from LACM since 1989.

After a brief bout with an inoperable cancer, Ralph Schreiber died on 29 March 1988. On 16 May 1988 a memorial gathering celebrating his life was held at the museum, attended by many of the ornithologists around the country with whom Ralph had a close friendship (Woolfenden 1989). Later that year Schreiber was honored with the AOU's Elliott Coues Award.

Exhibits.— For public exhibits, The Natural History Museum of Los Angeles County is perhaps best known for its world-renowned habitat dioramas, developed on the first and second floors from the 1940s to the 1960s. However, birds have been exhibited to the public in some form since the earliest days of the Museum. The 1948 iteration of the Hall of Birds (the "Bird and Small Mammal Hall") went beyond its minimal forebears by grouping southern California birds by habitat and introducing some biological approaches such as demonstrations of color and patterning. During her tenure at the museum, Hildegard Howard oversaw the preparation of the museum's first skeletal mounts of the extinct birds of Rancho La Brea, and many of these mounts were exhibited at the Exposition Park facility until they were moved to their cur-

rent location at the George C. Page Museum. The Page Museum exhibits include a representation of the avifauna of the Los Angeles region in the late Pleistocene based on fossils collected from the Rancho La Brea tar pits, including such iconic birds as *Teratornis merriami*.

Ralph and Elizabeth Anne Schreiber were convinced shortly after their arrival at the Museum that the 1948 public exhibit on birds needed to be updated, expanded, and enlivened. Through the 1980s they collected ideas, gleaned in part from the best bird exhibits in museums around the world. They also stepped up their fundraising efforts through a network of new and old museum supporters and charitable foundations. The old exhibit was deinstalled in 1988, and construction on the new hall, as well as a complete renovation of the bird and mammal collection and research area on the museum building's second floor, began. The collection renovation, funded in part by the National Science Foundation, included the installation of a manual compactorized carriage system for most of the existing steel skin cabinets and another for the spirit and skeleton collections. A larger specimen preparation laboratory was constructed, along with increased office space (over a third of which was reassigned to the museum's marketing department in the mid-1990s).

The new Ralph W. Schreiber Hall of Birds (its working title, the "Great Bird Hall," was changed by museum director Craig C. Black to honor Schreiber just before his passing early in 1988) opened in January 1991. As befitting what has unofficially been the "natural history museum to the stars," an announcement recorded by actor James Stewart was used in the hall's fundraising drive and the hall includes an animatronic welcoming lecture by "Professor Percy Pelican" featuring the voice of Jonathan Winters. The exhibit included over 600 bird specimens, twenty-seven interactive learning stations, and three walk-through habitat groups (a Canadian prairie marsh, a California oak woodland and "condor mountain," and a Peruvian Amazon rainforest). The interactive nature of much of the hall was an innovation for the museum, but the passing of the years has revealed the drawbacks of complex mechanical and/or computer-driven exhibitry (Percy Pelican, for example, was silent for several years).

An intermittent affair with the Western Foundation of Vertebrate Zoology.—Ed N. Harrison (1914-2002) was a prominent figure who

united two venerable southern California institutions, the Natural History Museum of Los Angeles County and the Western Foundation of Vertebrate Zoology. Harrison served on the Board of Governors of the Natural History Museum from 1955 to 1999, but he is best known for establishing with several partners an internationally important collection in Los Angeles in the 1950s, which came to be known as the Western Foundation of Vertebrate Zoology (Kiff 2000). The complex relationship between LACM and the WFVZ has been driven by persons with shared interests and allegiances and occasional tentative steps toward some kind of merger were contemplated several times; the closest these institutions came to a merger occurred in the early 1990s, as detailed by Kiff (2000).

With Ralph Schreiber's passing in March 1988 the museum had the challenge of completing the new Hall of Birds as well as pulling off the planned joint meeting of Cooper Ornithological Society and American Ornithologists' Union in Los Angeles in June 1990; this meeting was held on the campus of the University of California at Los Angeles (during what remains to this day a record heat wave for the city), but the annual banquet was hosted by the Museum on 30 June 1990. The Hall of Birds had been a collaboration between Ralph and his wife Elizabeth Anne from the start, and B.A. was the principle figure who oversaw the hall's completion. Lloyd Kiff (1942-) was appointed acting curator of ornithology in September 1988 in conjunction with a proposed merger being discussed by the governing boards of the Natural History Museum and the Western Foundation of Vertebrate Zoology (of which Kiff was curator and director); Kiff also helped guide the completion of the bird hall and became the driving force in arranging the 1990 joint COS/AOU meeting.

In September 1991 the proposed merger between the WFVZ and LACM was abandoned (Kiff 2000). During the ensuing period, until 1997, the ornithology program was guided by collections manager Kimball L. Garrett (1953-), who had been hired on soft money by Schreiber in March 1982, but continued in that position when the County of Los Angeles created the official job title of "collections manager" in 1985; Garrett remains in that position today.

A repository for information about the birds of Los Angeles County.—George Willett's three booklets on the birds of the coast,

mountains, and urban districts of the Los Angeles area (Willett 1942, 1943a, b) represented an initial conversation with the public about the region's extensive avifauna. Biota studies, which included in-depth analysis of the avifaunas of areas around Los Angeles, were conducted for the Ballona Wetlands (Schreiber 1981), the Los Angeles River (Garrett 1993), and the Baldwin Hills (Molina 2001). The Natural History Museum partnered with the Los Angeles Audubon Society to plan and conduct the Los Angeles County Breeding Bird Atlas; field coverage of all 410 atlas grid blocks was conducted from 1995 to 2000, data were collected and analyzed at the Museum's "Atlas Central" by Mark C. Wimer and Larry W. Allen, and the final publication is nearing completion. Quarterly reports of bird records in Los Angeles County for *North American Birds* (formerly *American Birds/Field Notes*) have been compiled since 1979 by Garrett, and those files, now entered into Access database, are available at the Museum to researchers. Garrett's research has centered on the naturalized populations of parrots and other non-native birds that are now a hallmark of the Los Angeles Region's avifauna (Johnston and Garrett 1994, Garrett 1997, Pranty and Garrett 2003). The avifauna of Los Angeles County is substantial; as of December 2008, 500 bird species have been recorded in the county (including seven established non-native species). This diversity has been celebrated since 1986 during the annual Dick Davenport Memorial Bird Walk, held in Exposition Park each November. The walk commemorates the comic-strip life of the Doonesbury character who succumbed while photographing a Bachman's Warbler (*Vermivora bachmanii*) in Yosemite National Park.

A RETURN TO PALEORNITHOLOGY ROOTS AND A NATURAL FUSION OF NEO- AND PALEO-ORNITHOLOGY

In 1997 the museum administration filled the vacant position of curator of ornithology through a lateral transfer of Vertebrate Paleontology curator Kenneth E. Campbell. Campbell (1943-) joined the Natural History Museum in 1977 after completing his doctorate at the University of Florida in 1973 under Pierce Brodkorb. With training in geology, paleontology, and ornithology, Dr. Campbell's direction of the ornithology program has continued a long tradition of avian paleontology at LACM. A conviction at the institution that an organizational

distinction between paleo- and neo-biological disciplines could hinder rather than help planning and research led to the merger in 2002 of the sections of vertebrate paleontology, ichthyology, herpetology (unstaffed since 2003), ornithology, and mammalogy into a single administrative unit (the Division of Vertebrate Studies). Campbell's doctoral work concerned the late Pleistocene paleoavifauna of the Talara Tar Seeps of northwestern Peru, and his recent field work has largely concerned the paleobiogeography of the upper Amazon Basin of South America. Using the museum's extensive osteological collections (now including over 12,000 complete skeletons), Campbell also conducts research on various aspects of avian functional morphology. Since 2000 he has served as president of the Society for Avian Paleontology and Evolution (SAPE), and convened and edited the proceedings of the second international symposium of the SAPE, held at LACM 28-30 September 1988 (Campbell 1992). This symposium and publication honored Brodkorb, his major professor. Earlier Campbell (1980) edited a volume of papers on avian paleontology honoring the Museum's Hildegard Howard (Figure 8). The strong program in vertebrate paleontology at LACM has made for fertile collaborations and fervent disagreements on matters of avian paleodiversity and origins. Curator of Paleontology Luis Chiappe (1962-), who also serves as director of the museum's recently-established Dinosaur Institute, arrived at LACM from the American Museum of Natural History in 1999 and continues to work on basal birds as well as dinosaurs.

FUTURE CHALLENGES

The Natural History Museum of Los Angeles County, in the 1990s and into the current millennium, has been something of a poster child for the problems faced by free-standing natural history institutions in the United States. The loss of tax revenues with the passage of California's "Proposition 13" in 1975 resulted in diminished governmental support and changes in revenue generation strategies. A general decrease in support for research and collections has resulted from these decreases in governmental support, but also from shifts in institutional priorities and the loss of older cohorts of community philanthropists and wealthy game hunters and other natural history aficionados. A large round of layoffs of staff positions in 1994 was followed by another in



Figure 8. Hildegarde Howard with Kenneth E. Campbell (left) and Museum Director Pete Lee at a celebration of the 1980 publication of an avian paleontology volume in her honor edited by Campbell. Courtesy of the Natural History Museum of Los Angeles County.

2003. Such reductions hit the vertebrate programs at LACM particularly hard. At the beginning of 1993, the vertebrate studies programs at LACM (excluding vertebrate paleontology) included seven curators and eleven other collection staff positions. After the 2003 layoffs, staffing was reduced to a total of two curators and five collections staff positions for all of ornithology, mammalogy, herpetology, and ichthyology.

In 2001 the museum adopted the statement that “The mission of the Natural History Museum of Los Angeles County is to inspire wonder, discovery and responsibility for our natural and cultural worlds.” The Museum’s long ornithological tradition and exceptional avian collections play an important role in fulfilling this mission. The current reinvention of the Natural History Museum of Los Angeles County is developing, in part, from the need to seismically upgrade the oldest part of the building which was completed in 1913 as well as the adjoining portions of the building that were built in the 1920s. Wholesale changes in

exhibit and collections spaces with planned, phased modifications to the remainder of the Museum building are being considered by the current Museum administration. The impacts on ornithology of any such changes are currently unclear.

ACKNOWLEDGMENTS

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LITERATURE CITED

- Campbell, K. E., Jr. (ed.). 1980. Introduction. Pp. i-xxv, in *Papers in Avian Paleontology Honoring Hildegard Howard*. Natural History Museum of Los Angeles County, Contributions in Science no. 330.
- Campbell, K. E., Jr. (ed.). 1992. *Papers in avian paleontology honoring Pierce Brodkorb*. Natural History Museum of Los Angeles County, Science Series, no. 36.
- Campbell, K. E., Jr. 2000. In memoriam: Hildegard Howard, 1901-1998. *Auk* 117:775-779.
- Delacour, J. 1957. The Machris Brazilian expedition. Los Angeles County Museum, Contributions in Science no. 1.
- Dickey, D. R., and A. J. van Rossem. 1925. A revisionary study of the Western Gull. *Condor* 27:162-164.
- Friedmann, H. 1962. The Machris expedition to Tchad, Africa. *Birds*. Los Angeles County Museum, Contributions in Science no. 59.
- Friedmann, H. 1966. A contribution to the ornithology of Uganda: Scientific results of the 1963 Knudsen-Machris Expedition to Kenya and Uganda. *Bulletin of the Los Angeles County Museum of Natural History*, Science no. 3.
- Friedmann, H. 1978. Results of the Lathrop Central African Republic expedition 1976. *Ornithology*. Los Angeles County Museum, Contributions in Science no. 287.
- Friedmann, H. 1980. *A bestiary for St. Jerome: animal symbolism in European religious art*. Smithsonian Institution Press, Washington, D.C.

- Friedmann, H., and J. R. Northern. 1975. Results of the Taylor South West African expedition, 1972. Ornithology. Los Angeles County Museum, Contributions in Science no. 266.
- Friedmann, H., and K. E. Stager. 1964. Results of the 1964 Cheney Tanganyikan expedition. Ornithology. Los Angeles County Museum, Contributions in Science no. 84.
- Friedmann, H., and K. E. Stager. 1967. Results of the 1966 Cheney expedition to the Samburu District, Kenya. Ornithology. Los Angeles County Museum, Contributions in Science no. 130.
- Friedmann, H., and K. E. Stager. 1969. Results of the 1968 Avil expedition to Mt. Nyiru, Samburu District, Kenya. Ornithology. Los Angeles County Museum, Contributions in Science no. 174.
- Friedmann, H., and J. G. Williams. 1969. The birds of the Sango Bay forests, Buddu County, Masaka District, Uganda. Los Angeles County Museum, Contributions in Science, no. 162.
- Friedmann, H., and J. G. Williams. 1970. The birds of the Kalinzu Forest, southwestern Ankole, Uganda. Los Angeles County Museum, Contributions in Science, no. 195.
- Friedmann, H., and J. G. Williams. 1971. The birds of the lowlands of Bwamba, Toro Province, Uganda. Los Angeles County Museum, Contributions in Science, no. 211.
- Fuller, E. 1999. *The Great Auk*. Harry N. Abrams, New York.
- Garrett, K. L. 1990. Ornithology and the Natural History Museum of Los Angeles County. *Terra* 28(4):44-48.
- Garrett, K. L. (ed.). 1993. The biota of the Los Angeles River. Natural History Museum Foundation. Report to California Department of Fish and Game, Contract FG-0541.
- Garrett, K. L. 1997. Population status and distribution of naturalized parrots in southern California. *Western Birds* 28:181-195.
- Howard, H. 1946. George Willett: May 28, 1879-August 2, 1945. *Condor* 48:49-71.
- Johnston, R. F., and K. L. Garrett. 1994. Population trends of introduced birds in western North America. Pp. 221-231 in J. R. Jehl, Jr. and N. K. Johnson, eds., *A Century of Avifaunal Change in Western North America*. Studies in Avian Biology no. 15.
- Kiff, L. F. 2000. A history of the Western Foundation of Vertebrate Zoology, 1956-1994. Pp. 183-228 in W. E. Davis, Jr. and J. A. Jackson, eds., *Contributions to the History of North American Ornithology*, vol. 2. *Memoirs of the Nuttall Ornithological Club*, no. 13.
- Law, J. E. 1912. Minutes of Cooper Club meetings. Southern Division. *Condor* 14:50-51.
- Linsdale, J. M. 1936. Harry Schelwald Swarth. *Condor* 38:155-168.
- Mayr, E. 1986. In memoriam: Jean (Theodore) Delacour. *Auk* 103:603-605.
- Miller, L. 1912. Minutes of Cooper Club meetings, Southern Division. *Condor* 14:201.
- Molina, K. C., ed. 2001. The biota of the Baldwin Hills, an ecological assessment. Community Conservancy International and Natural History Museum of Los Angeles County Foundation, Los Angeles, California. [Available online at: <http://www.bhc.ca.gov/documents/cover.pdf>]
- Pranty, B., and K. L. Garrett. 2003. The parrot fauna of the ABA area: a cur-

- rent look. *Birding* 35:248-261.
- Rothstein, S. I., R. W. Schreiber, and T. R. Howell. 1988. In memoriam: Herbert Friedmann. *Auk* 105:365-368.
- Schreiber, R. W. (ed.). 1981. The biota of the Ballona Region, Los Angeles County. (Supplement I of Marina del Rey Ballona Local Coastal Plan). Los Angeles County Natural History Museum Foundation.
- Schreiber, R. W., and E. A. Schreiber. 1984. Central Pacific seabirds and the El Niño Southern Oscillation: 1982 to 1983 perspectives. *Science* 225:713-716.
- Sibley, G. 1978. Sixty-five and still growing. *Terra* 16(3):3-30.
- Stager, K. E. 1961. The Machris Brazilian expedition. Ornithology: non-passerines. Los Angeles County Museum, Contributions in Science no. 41.
- Stager, K. E. 1964. The role of olfaction in food location by the Turkey Vulture (*Cathartes aura*). Los Angeles County Museum Contributions in Science, no. 81.
- Swarth, H. S. 1920. In memoriam: Frank Slater Daggett. *Condor* 22:129-135.
- Willet, G. 1912. Birds of the Pacific slope of southern California. Pacific Coast Avifauna, no. 7.
- Willet, G. 1933. A revised list of the birds of southwestern California. Pacific Coast Avifauna, no. 21.
- Willet, G. 1942. Common birds of the Los Angeles County coast. Los Angeles County Museum, Science Series, no. 5, Zoology Publication no. 1.
- Willet, G. 1943a. Common birds of the Los Angeles County mountains. Los Angeles County Museum, Science Series, no. 6, Zoology Publication no. 2.
- Willet, G. 1943b. The birds of the urban districts of Los Angeles County coast. Los Angeles County Museum, Science Series, no. 7, Zoology Publication no. 3.
- Woolfenden, G. E. 1989. In memoriam: Ralph W. Schreiber, 1942-1988. *Auk* 106:137-140.

History of Ornithology at Tall Timbers Research Station

Robert L. Crawford¹ and R. Todd Engstrom²

ABSTRACT.—Tall Timbers Research Station is an independent non-profit ecological research station founded in 1958 in the Red Hills physiographic region between Thomasville, Georgia, and Tallahassee, Florida. After a study of the native Northern Bobwhite (*Colinus virginianus*), Herbert L. Stoddard identified a need for fire ecology research at a local field station. Stoddard cultivated a friendship with Red Hills landowner Henry Beadel, who donated the land and financing for a facility after Stoddard's study of bird mortality at the neighboring WCTV tower further demonstrated the potential for a research facility. Over its 50-year history, enduring themes of ornithological research at Tall Timbers have been the long-term study of bird migration from television tower kills, bird response to fire, autecological studies of the bird species most closely associated with fire-maintained ecosystems, and the ecology and management of the Northern Bobwhite. The station has a small, well-maintained bird skin collection, a library, grounds of approximately 1600 ha, and many more hectares available for research. Research emphasis has been on long-term field experiments. Currently, the game-bird program has projects on aspects of bobwhite ecology and management (population genetics, effects of predation, scale of management, etc.), and the avian ecology program has projects on pine woods birds (Red-cockaded Woodpecker, *Picoides borealis*; Brown-headed Nuthatch, *Sitta pusilla*; Bachman's Sparrow, *Aimophila aestivalis*). Both the game-bird and avian-ecology programs have active internships and there is a strong land conservation effort that encourages environmental easements within the Red Hills region.

THE BEGINNINGS

The ornithological history of Tall Timbers Research Station is that of the institution itself, for its roots are in the ecology of one bird species, and its formal establishment came about through a bird migration and mortality study.

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The seed that germinated into Tall Timbers Research Station was created when Samuel Prentiss Baldwin married Lillian Converse Hanna on 15 February 1898 (Kendeigh 1940). Both were of prominent Cleveland, Ohio, families and some of Miss Hanna's siblings had become extraordinarily wealthy through John D. Rockefeller's Standard Oil Company. Her brothers Marcus A. Hanna and Howard M. Hanna, and her sisters Solome and Seville all had high connections with Standard Oil, the brothers directly and the sisters through their husbands (Brueckheimer 1982).

Towards the end of the 19th century, these Hannas, along with several other Cleveland business partners and friends, acquired large hunting plantations in a scenic physiographic region between Tallahassee, Florida, and Thomasville, Georgia, called the Red Hills. Their new holdings teemed with game and fish, all of which they pursued, but their favorite was the abundant native quail, the Northern Bobwhite (*Colinus virginianus*). The winter homes became quail plantations, and the quail thrived in the system of scattered agricultural fields surrounded by pine woodlands that were a natural fire ecosystem (Paisley 1989). The pine woods burned periodically because of lightning strikes or deliberately-set fires that had been a part of local culture from aboriginal prehistory.

About 1920 the U.S. Forest Service joined a warped effort to eliminate fire from all woodlands. The Forest Service, "... condemned fire for all purposes and at all times. To get their program over they played on the emotions of people and much of this early propaganda was directed at the assumption that fire was deadly for all wildlife" (Komarek 1982:18). With fire forbidden and suppressed, the forests began to grow into thickets with the shrubby subcanopy shading out the luxuriant herbaceous grassy floor that had produced forage for the quail. "As this program of total fire exclusion took hold, quail populations dropped. Quail hunting consequently became difficult and of poor quality" (Komarek 1977:18). The Hannas and their friends despaired.

Meanwhile, S. Prentiss Baldwin (1868-1938), after leaving a law practice because of poor health, had become a pioneer in scientific bird banding. Beginning in 1914, Baldwin trapped and banded birds on his estate in Gates Mills, Ohio. He and his wife Lillian usually spent two months of each late winter with Seville and her husband Jay C. Morse at their Inwood Plantation near Thomasville. In 1915 Baldwin set up traps on Inwood and began banding there (Kendeigh 1940; Figure 1).



Figure 1. S. Prentiss Baldwin at work banding birds in Thomasville in the 1920s. Photograph from S. Prentiss Baldwin.

Baldwin documented the site fidelity of wintering birds by trapping marked individuals in consecutive winters, very often in the same trap sites. He presented his preliminary findings at the 1919 American Ornithologists' Union (A.O.U.) meeting in New York City, and in a publication of the Linnaean Society (Baldwin 1919). Baldwin expanded his Thomasville banding and brought in assistants, some of whom published their results independently in *The Auk* (e.g., Baldwin 1921, 1922; Talbot 1922, Musselman 1923). Baldwin, with others, published many important papers on bird-banding results and techniques under the auspices of his Baldwin Bird Research Laboratory (see Bibliography in Kendeigh [1940] and "Contributions from the Baldwin Bird Research Laboratory," in Baldwin et al. [1931:167-169]).

Unlike his in-laws, Baldwin was not a hunter, but he enjoyed accompanying his friends and relatives as they stalked bobwhites (Kendeigh 1940). He had begun to suggest to the plantation owners that the answer to their problem of dwindling quail numbers might be found through a scientific investigation using banding as a tool (Baldwin 1925).

In October 1922, while at the A.O.U. meeting in Chicago, several bird-banders from the Midwest founded the Inland Bird Banding

Association. One of the group was Herbert L. Stoddard, a 33-year-old museum collector and taxidermist, whose burgeoning interest in scientific ornithology had encompassed banding, and as a result, its relatively small universe of practitioners. Stoddard had a talent for making friends. He was named Treasurer of the new organization, and he knew Samuel Perkins, Jr., who had been one of Baldwin's assistants in Thomasville the previous spring. He also met W. L. McAtee of the U.S. Bureau of Biological Survey. (Baldwin 1925, Stoddard 1969:165,174-175).

By 1923 Baldwin had convinced some key plantation owners of the value of a scientific investigation of their disappearing quail, and on 23 April 1923, Charles M. Chapin hosted a luncheon at the Links Club in New York City to decide whether a Committee of Sportsmen should be organized to finance an investigation; attendees included Frederick C. Lincoln, representing the Biological Survey; Baldwin, representing the Inland Bird Banding Association; John T. Nichols of the American Museum of Natural History, as advisor; and a half-dozen other Red Hills Plantation owners (Baldwin 1925).

A deal was struck, with the landowners promising to finance the study and the Bureau agreeing to oversee the scientific end. In 1924 the Co-operative Quail Investigation was organized. Herbert L. Stoddard was called on to head the study; he had been recommended to E. W. Nelson, Chief of the Biological Survey, by Baldwin and McAtee (Baldwin 1925, Stoddard 1969:176-177, Rogers 1989:115-116.)

THE CO-OPERATIVE QUAIL INVESTIGATION

Although born in Rockford, Illinois, Herbert L. Stoddard (1889-1968) spent his formative childhood enduring a rough subsistence living on the central Florida frontier. After his family returned to Rockford in 1900, Stoddard quit school at 16 and pursued his goal of becoming a professional taxidermist. A knack for knowing the right people at the right time served him well, and he was employed by museums in Milwaukee and Chicago until 1922. He read ornithological journals voraciously and by the time he was chosen for the quail study, he was self-educated, well-acquainted with most of the prominent ornithologists of the day, fit and used to rigorous field work, and blessed with keen powers of observation (Stoddard 1969, Gromme 1973).

These talents were put to immediate use to fulfill the charge given to Stoddard by E. W. Nelson: “. . . make a study of the life history of the quail in southern Georgia, its relations to its environment, and all factors, both favorable and unfavorable to maintenance of an abundant supply of these birds” (Komarek 1977:18-19).

Stoddard, with Charles O. Handley as assistant, plunged into the study. He surveyed the plantations, interviewed personnel, trapped and banded quail, listened, and observed. He also made many important and lasting friends in the area.

The work extended from 17 March 1924 to 30 June 1929, after which Stoddard labored on his report of the findings. He produced *The Bobwhite Quail, Its Habits, Preservation and Increase* (Stoddard 1931), but not without difficulty and controversy.

Stoddard's sponsor, the Biological Survey, was “one of the smallest bureaus of the U.S. Department of Agriculture, while the Forest Service was one of the largest and most powerful” (Stoddard 1962a). The Forest Service, with its anti-fire zeal, objected to one of Stoddard's most important conclusions: “The bobwhite . . . undoubtedly evolved in an environment that was always subject to occasional burning over,” and that in the southeastern pine woods, “fire may well be the most important single factor in determining what animal and vegetable life will thrive in many areas” (Stoddard 1931:401-402).

Stoddard won the argument, and his book was published with the fire chapter included. Stoddard recognized that the impacts of fire on plant and animal communities were, “. . . a complex problem [that] would require years of careful research on the part of . . . a well-equipped experiment station” (Stoddard 1931:402). The idea of a local research facility devoted to what could be called fire ecology was placed on the table, and every plantation owner in the Red Hills read the sentence.

Stoddard's *Bobwhite Quail* was an immediate success, both locally among the landowners, who by adopting his management suggestions saw their quail return, and among Stoddard's professional peers. In 1935 the A.O.U. presented him with its most prestigious award, the Brewster Medal, and the next year elevated him to the highest level of elected membership, Fellow.

Stoddard (Figure 2) and the sportsmen formed the Cooperative Quail Study Association to continue consulting wildlife management research services for the plantations. Henry L. Beadel, of Tall Timbers



Figure 2. (left to right) E. V. Komarek, Herbert L. Stoddard, and W. L. McAtee, taken about 1938 at an unknown location by E. R. Greene and used in *A Lifetime with the Birds* (Greene 1966).

Plantation in Leon County, Florida, was elected Secretary, and represented the landowners, and Stoddard hired two Chicago mammalogists, brothers E. V. and Roy Komarek as assistants. The Association disbanded in 1943 (Stoddard et al. 1961), but by then Stoddard had established a successful forestry and wildlife management practice and so he remained in the area and in close interaction with the plantations.

GEORGIA BIRDS

Stoddard remained active in ornithology as well. He collaborated with prominent ornithologists to investigate migration and distribution in the Southeast (McAtee et al. 1944; Greene et al. 1945), and especially near his home in Beachton, Georgia (Stoddard 1951). He joined George Lowery's moon-watching migration study in 1948 and continued observing into the 1960s (Lowery 1951).

He began a manuscript on the birds of Grady County, Georgia (Stoddard 1978), and collected specimens to document his records. Stoddard also collected among the winter resident and transient species

that were polytypic; the scores of specimens were sent to the U.S. National Museum where professionals like Thomas D. Burleigh made the difficult subspecific identifications. The museum kept examples of each taxon, and returned the others to Stoddard. These specimens and his local contacts allowed Stoddard to play a critical role in bringing Burleigh's *Georgia Birds* to print (Burleigh 1958). Stoddard's Grady County specimens were the basis for much of Burleigh's discussions of southwestern Georgia species, and Stoddard organized a list of subscribers from his plantation clients to fund the book (Burleigh 1958:733-734). A grateful Burleigh dedicated the book to Stoddard.

Especially pleasing was his collaboration with the artist and ornithologist George Miksch Sutton, who produced the plates for *Georgia Birds*. Sutton spent the spring and summer of 1952 as



Figure 3. Herbert L. Stoddard (left) and George M. Sutton in July 1952 discussing a painting of a Black Skimmer (*Rhynchops niger*) that became a plate in *Georgia Birds*. Photograph courtesy of Tall Timbers Research Station.

Stoddard's guest in Grady County, and Stoddard collected many of the specimens Sutton painted so superbly. Sutton's essay about his stay with Stoddard (*in* Burleigh 1958:xv-xix) and his charming vignettes about each painting highlight the book. The original vivid watercolors are owned by Tall Timbers Research Station and are occasionally displayed (Figure 3).

THE WCTV TOWER STUDY

In 1955, when Herbert L. Stoddard was 66 years old, he took on the last and perhaps the most demanding endeavor of his life. One of Stoddard's plantation friends, John H. Phipps, acquired a license for a television station to serve the communities of Thomasville and Tallahassee. An ideal site for the transmitting tower was on Henry L. Beadel's Tall Timbers Plantation and Stoddard persuaded his old friend Beadel to accept the structure onto his property.

Stoddard knew that migrating birds were frequently killed by striking transmitting towers, and if he arranged for this one to be built on property he managed for a friend, and very close to his own home, he could collect the inevitable dead birds as part of a study of tower mortality and migration. Stoddard's arrangement between Beadel and Phipps was legally consummated and in mid-1955, construction of a 195-m- (641-foot-) tall transmitting tower for WCTV was begun on Tall Timbers Plantation.

A month after the tower was erected, on 2 October 1955, Stoddard made the first of what would eventually be about 10,300 search days at the WCTV tower. Just one week later, on 9 October, he found the largest kill he would encounter; estimated to be 4000 dead birds or more, most were lost in weedy fields and the ruin of a house site.

The experience convinced him that to efficiently find the birds and produce meaningful results, he must clear the grounds and plant grass. Stoddard began a laborious, expensive land-clearing operation that eventually yielded 12.6 ha of Bermuda grass (*Cynodon dactylon*) that was mowed weekly. No other tower had its grounds especially prepared for locating dead birds. He also had to control scavenging predators that contended with him for the dead birds. After August 1956, the grounds were searched for dead birds every day, a practice continued by others through December 1983. All of these activities entailed immense effort,

and so by his thoroughness Stoddard set the standard to which other tower studies would be compared (Figure 4).

From the start, Stoddard's work produced startling migration records and thousands of valuable research specimens. Stoddard published two papers on his tower results, and others appeared after failing health forced him to quit the work in 1967 (Stoddard 1962b, Stoddard and Norris 1967, Crawford 1974a, 1981a). Stoddard died on 15 November 1970 (Gromme 1973). Until daily searches were discontinued after 1983, 44,007 birds were tallied over about 3579 of the 10,300 search days.

The prodigious data revealed a lucid picture of migration in north Florida, how it is influenced by weather (Crawford 1981b), and with the species and dates carefully confirmed. WCTV-tower records filled the



Figure 4. Herbert L. Stoddard conducting survey of bird kills from a Volkswagen at the WCTV tower grounds. Photograph courtesy of Tall Timbers Research Station.

pages of *Audubon Field Notes/American Birds* Florida region reports, and the two most recent treatments of Florida birds rely heavily on WCTV tower data (Robertson and Woolfenden 1992, Stevenson and Anderson 1994). Like *Georgia Birds*, Stevenson and Anderson's *The Birdlife of Florida* is dedicated to Herbert L. Stoddard. Analysis of the WCTV data is still ongoing (Crawford and Engstrom 2001). Stoddard's efforts at the WCTV tower in the 1950s and 1960s were detailed by Crawford (2004).

The WCTV Tower specimen studies.—After being tallied for migration data, the dead birds collected by Stoddard and others were a treasure trove for ornithologists needing bird carcasses en masse for tissue studies and demographic data. Carefully bagged, labeled, and frozen, thousands of WCTV birds were shipped to universities and museums across North America.

Undoubtedly most went to Eugene P. Odum and his students at the University of Georgia for their work on avian flight energetics and fat deposition (Odum et al. 1961, Marshall and Baker 1964). Another major recipient of WCTV birds was David W. Johnston, then at the University of Florida, who used the birds in studies of Indigo Buntings (*Passerina cyanea*), Palm Warblers (*Dendroica palmarum*), and the accumulation of pesticides in migratory species (e.g., Johnston 1967, 1968, 1974). Many others benefited similarly (references in Komarek 1977 and Crawford 1981a).

More thousands of WCTV birds were prepared as study skins, taxidermy mounts, and skeletons for display, comparison, and documentation and they may be found in scores of museums. Stoddard continued his practice of sending skins to the U.S. National Museum where the specimens were identified and returned to Tall Timbers.

TALL TIMBERS RESEARCH STATION

A direct result of the WCTV study was the formal establishment of Tall Timbers Research Station. Stoddard, the Komarek brothers, Leon Neel, and others often discussed with Henry "Harry" Beadel of Tall Timbers Plantation the idea of a wildlife experiment station on Beadel's property (Komarek 1982:180), pursuant to Stoddard's 1931 suggestion in *The Bobwhite Quail*. Henry L. Beadel (1875-1963) was the childless

heir to a fortune rooted in lower Manhattan real estate. A keen sportsman, he was also an accomplished naturalist, and a pioneer wildlife cinematographer (Figure 5; Beadel 1939, Beadel and Stoddard 1939).

The tower study was the impetus. "Harry was very much interested in the [WCTV] project, and pleased that scientific wildlife research was being conducted on his property. That study ultimately led to the founding of Tall Timbers Research Station . . ." (Stoddard 1969:283). The first organizational meeting of Tall Timbers Research, Inc. was on 15 March 1958 (Komarek 1977:6; 1982:181), two-and-one-half years after the WCTV tower study began. E. V. "Ed" Komarek (1909-1995) became executive secretary of Tall Timbers Research Station, a position



Figure 5. Henry L. Beadel with a camera mounted on a gunstock for bird photography. Photograph courtesy Tall Timbers Research Station.



Figure 6. Some of the concept developers of Tall Timbers Research Station: (left to right) Herbert L. Stoddard, E. V. Komarek, "Cowboy" Stevens (an agronomist), and Henry Beadel at E. V. Komarek's home in 1958. Photograph courtesy Tall Timbers Research Station.

essentially that of chief executive officer, and secretary-treasurer of the board of directors; Roy Komarek (1911-1989) served as president of the board and as editor for the *Tall Timbers Bulletin* and *Proceedings* series (Figure 6). Stoddard was an original board member as were two other ornithologists of note: C. Russell Mason and Samuel A. Grimes (Powell 1997).

The new organization formally incorporated the WCTV project as a Station effort. Stoddard's private bird collection became the nucleus of the Tall Timbers Research Station scientific specimen collection—a priceless heritage with thousands of skins prepared with Stoddard's matchless taxidermy skill.

In July 1962, Robert A. Norris joined the staff of Tall Timbers Research Station to assist Stoddard in the WCTV study. Norris used WCTV specimens to further his work on systematic applications of avian blood groups (Norris 1963, Figure 7). He contributed considerably to the second *Tall Timbers Bulletin* on the WCTV study (Stoddard and Norris 1967) after leaving the staff in 1966.



Figure 7. Robert L. Norris and Julie Neel banding Ring-necked Ducks (*Aythya collaris*) at Tall Timbers about 1963. Photograph courtesy Leon Neel.

The physical plant.—Henry Beadel's endowment included a working quail plantation of about 1138 ha, with agricultural fields, annually-burned old-field pine forests about 80 years old, and some American beech (*Fagus grandifolia*)-southern magnolia (*Magnolia grandiflora*) hammocks. The size of the research station has grown through land gifts or purchases to the current total of 1615 ha. With the exception of the Woodyard Hammock, all of the land at Tall Timbers had been heavily disturbed by human agriculture and forestry, so there was no old-growth longleaf pine (*Pinus palustris*) on the property. In 1979 a conservation easement, the first in Georgia and one of the first in the southeastern United States, was donated to Tall Timbers, encompassing an 83-ha stand of old-growth longleaf pine forest, known as the Wade Tract, that was part of Arcadia Plantation near Thomasville. The easement was specifically established to enable research on that endangered ecosystem. The Pebble Hill Foundation made the 1214-ha Pebble Hill Plantation located between Tall Timbers and Thomasville, Georgia, available to Tall Timbers through a 5-year renewable management agreement in 1992. These properties considerably expanded the land base for research opportunities at Tall Timbers.

The buildings associated with the original quail plantation included a main house, servant's quarters, and various outbuildings. Shortly after the establishment of Tall Timbers as a research station, the Mellon Laboratory was built in 1961 (Figure 8a), followed by the Stoddard Lab (669 m²) in 1969 and 1973, the Flowers Lab in 1981 and the Wade Research Center (an addition to the Stoddard Lab; 1394 m²) in 2001 (Figure 8b). Currently, the Wade Research Center and Stoddard Wing are the buildings used for research. The former servant quarters have been converted to living space for students, technicians, and visiting scientists. The Main House was restored and is currently used for administrative offices; the barn has become a lecture hall and offices.

Tall Timbers bird collections.—The Tall Timbers Museum began as Herbert L. Stoddard's personal collection that he accumulated from the 1920s onward around his home in Grady County, Georgia, and the nearby coastal areas of Franklin and Wakulla counties in Florida. Stoddard's Georgia specimens were important for Burleigh's (1958) species and subspecies accounts in *Georgia Birds*, and after Stoddard began the WCTV tower study, he salvaged many of the casualties as study skins. There are about 1800 WCTV specimens and about 490 specimens from Grady County in the collection.



Figure 8. (8a, left). The Mellon Lab was the first building constructed for Tall Timbers Research Station. Built in 1961, funded by a grant from Richard King Mellon, it was extensively renovated in 2007-2009 to be an archives repository. Photograph courtesy of Tall Timbers Research Station. (8b, right). The Wade Research Center, completed in 2001, incorporates the original Stoddard Laboratory, which was constructed in 1969. Photograph courtesy of Robert L. Crawford.

The collection consists of about 3900 specimens, mostly skins, with some skeletal and wet preserved material. Although most are passerines, 565 species are represented. Most are from Florida (2861) or Georgia (630) but others came from 24 countries and 37 states. There are many historic distributional voucher specimens for Georgia and Florida (see Crawford 1974b, Robertson and Woolfenden 1992, Stevenson and Anderson 1994, Graves 1993, Greenlaw and Engstrom 2001). Tall Timbers also has a bird photograph archive for documenting rarities. With over 600 images it is one of the largest repositories for Florida, and there are many Georgia records as well. Data for all the specimens and images are available at <http://www.talltimbers.org/museum.html>. Access to the specimens and loans is limited but can be arranged.

The Red Hills.—Hunting estates make up approximately 1214 km² of the Red Hills physiographic region between Thomasville, Georgia, and Tallahassee, Florida. Currently, about 100 estates provide a region of semi-wild land that includes some of the finest examples of relatively undisturbed ecosystems in the Southeast.

The landscape context of Tall Timbers is notable both for its historical importance in the establishment of the research station and as a source of sites for research on birds (e.g., Cox and Engstrom 2001). Encroaching real estate development, primarily from Tallahassee, Florida, just 9 km to the south, threatened the Red Hills hunting plantations and prompted Tall Timbers to begin a large-scale land conservation effort. With the Wade Tract conservation easement as an example, Tall Timbers entered into a consortium of conservation organizations that sought to preserve the ecological and cultural values of the Red Hills hunting estates. The conservation program at Tall Timbers has grown into a land conservancy that holds conservation easements on approximately 44,500 ha of the Red Hills hunting estates, many with tracts of longleaf pine habitat. Reaching out to the hunting estate owners for conservation was coupled with redevelopment of the game-bird program at Tall Timbers to provide research products of interest and benefit to the land owners.

Grants, scholarships, and fellowships.—Tall Timbers has supported ornithological research through grants, the Gerald Beadel Scholarship for students, and the Henry L. Beadel Fellowship for sen-

ior researchers. Tall Timbers has given grants to E. R. Graf for a study of the electromagnetic influence of a tall antenna tower upon the flight path of migrating birds (1975) and Forest Kellogg for studies of management of the Northern Bobwhite. The Gerald Beadel Scholarship Grant has been awarded to students for projects on bird populations in polluted marshes (Weiser 1973), Great Egrets (*Ardea alba*; Wiese 1975), the peninsula effect (Wamer 1978), the species-area effect in pinewoods bird communities (Engstrom 1979), and the Limpkin (*Aramus guarauna*; Bryan 1981). The Henry L. Beadel Fellowship assisted Henry M. Stevenson as he continued his long-term studies of Florida birds after his retirement from Florida State University. That effort resulted in his *magnum opus* on Florida birds (Stevenson and Anderson 1994; Figure 9).

Connections with academic institutions.—From its inception Tall Timbers fiercely maintained its independence from government and academia, although it entered many mutually beneficial partnerships



Figure 9. Tall Timbers Beadel Fellow Henry M. Stevenson at work on *The Birdlife of Florida* (Stevenson and Anderson 1994). Photograph courtesy of Bruce Anderson.

with both. Henry Stevenson of Florida State University and Eugene Odum of the University of Georgia were early connections with regional academic institutions. One particularly fruitful connection was between W. Wilson Baker and his alma mater, Earlham College in Richmond, Indiana. Baker maintained a close relationship with his mentor at Earlham, James B. Cope, after he became the staff vertebrate ecologist at Tall Timbers. Cope brought numerous students on several field trips during the late 1960s and early 1970s, and Baker selected interns (T. Brush, T. Cope, and R. T. Engstrom) from Earlham College for studies of the Red-cockaded Woodpecker (*Picoides borealis*) at Tall Timbers. Engstrom continued this tradition of picking interns from Earlham College (e.g., Megan and Damon Hearne) after he became vertebrate ecologist at Tall Timbers in 1990.

Auburn University (Dan Speake), the University of Georgia (Forest Kellogg, Randall Davidson, Sydney Johnson, John Carroll), Mississippi State University (Wes Burger), and North Carolina State University (P. Bromley, Phil Doerr) have all been prime recruiting grounds for students and technicians who have conducted research on game birds at Tall Timbers.

Institutional publications.—Tall Timbers has published a variety of in-house scientific publications including the *Fire Ecology Conference Proceedings* (1962 to present; 22 volumes), the *Bulletin* series (1962 to 1992; 26 volumes), the *Miscellaneous* series (1961 to present; 12 volumes), the *Ecological Animal Control by Habitat Management Conference Proceedings* (1969 to 1980, 7 volumes), and *Gamebird Workshop and Seminar Proceedings* (intermittent 1980 to present). All of these publications series have some papers related to ornithology.

GAME BIRD STUDIES

The Northern Bobwhite drew Herbert L. Stoddard to the Red Hills and attention to this species at Tall Timbers first appeared in publications of the Southeastern Cooperative Wildlife Disease Study. In addition to the study of diseases, managers and researchers were “encouraged to come to Tall Timbers Research Station and see the management methods in practice that consistently produce high bobwhite popula-

tions" (Komarek 1977:59). Staff positions were designated for game-bird research in the early 1980s and the program has continued to grow.

The Southeastern Cooperative Wildlife Disease Study.—Forest Kellogg, who as a young graduate student had ferried WCTV birds to Eugene Odum in 1961, began a study of bobwhites on Tall Timbers and adjacent lands in 1964 (Kellogg and Prestwood 1968, Kellogg et al. 1970). This was a cooperative effort between Tall Timbers and the Southeastern Cooperative Wildlife Disease Study, part of the College of Veterinary Medicine at the University of Georgia, and it blossomed into a long-term, multi-faceted study of bobwhite ecology. It had two main thrusts: a massive field study of bobwhite populations on large study plots, and necropsies of resultant specimens.

Principle investigators were Kellogg, William R. Davidson, and Gary L. Doster, along with scores of other scientists and students whose work on the project provided them with valuable experience and subjects for several master's theses and doctoral dissertations, and dozens of published reports (Figure 10).

In 1970 these investigators established two primary study areas on Tall Timbers of 202 and 210 ha. Through 1993 agriculture on the two sites was manipulated and bobwhite were trapped and banded. Density estimated from trapping was one bobwhite per 2 ha, with a mean of 560



Figure 10. Forest Kellogg, one of the original principal investigators of Tall Timbers' long-term bobwhite study. Photograph courtesy of Gary Doster.

birds banded per year. Subsequent systematic shooting harvests enabled a Lincoln Index for population estimates, and the large sample sizes provided a reliable base against which other techniques were tried and compared (Dimmick et al. 1982, Kellogg et al. 1982).

Data from thousands of individually marked birds, retrapped or collected, allowed analyses of demographics and individual ranges (Smith et al. 1982, Pollock et al. 1989). In addition to inspecting each bird handled, a random sample of 50 of the collected birds were necropsied each year, resulting in a uniquely thorough investigation of bobwhite parasite and disease burdens (e.g., Kellogg and Doster 1972, Davidson et al. 1991, and papers therein).

The Southeastern Cooperative Wildlife Disease Study's (SECWDS) Northern Bobwhite project on Tall Timbers Research Station was probably the most meticulous long-term lab and field study of the species. Insights about management, populations, disease, and parasites were applicable to many other species of birds, and so the contribution was to a wide range of ornithology. After 1993, the study was continued by Tall Timbers personnel instead of being directed by the SECWDS, but most of its basic design features are retained to the present.

Game bird management.—D. B. Means, then director of Tall Timbers, put forward a concept in 1980 to supplement the ongoing Southeastern Cooperative Wildlife Disease Study that was conducted for the most part by visiting researchers with “experimental, year-round research conducted by [Tall Timbers] staff” (Means 1980). The view, expressed by one of the owners of a local hunting estate, was that Tall Timbers should develop something along the lines of the Cooperative Quail Study Association (Chapin 1980). Means had extended his studies of the eastern diamondback rattlesnake (*Crotalus adamanteus*) to cover many other Red Hills hunting estates. This expanded research area would be the template for a game bird research program that would use “. . . the thousands of acres of laboratory in the form of local plantations” and renew the “longstanding landowner-scientist partnership, the primary thrust of which would be communication” (Chapin 1980). The technology that Means believed would enable researchers to learn more about free-living quail in a shorter period of time was radiotelemetry. Means set the goal to “develop the greatest capability possible for



Figure 11. Brad Mueller (left) and Lorvel “Smiley” Shields attaching an early model radio transmitter to a bobwhite at Tall Timbers. Photograph courtesy of Brad Mueller.

knowing the population levels of the bobwhite that can be reliably produced on a given piece of land—and at the cheapest cost” (Means 1980).

Lorvel Shields was hired as both a biologist and an engineer in 1981 to engage in telemetry research of quail and rattlesnakes. Shields and his assistant, Brad Mueller, worked to perfect radio transmitters that allowed them to monitor quail movements (Shields et al. 1982) and small birds (Shields and Mueller 1983; Figure 11). Radiotelemetry became the primary method used in studies of aspects of quail life history and management, including mortality in relation to prescribed fire (Mueller and Atkinson 1985) and pen-raised quail (Mueller 1985). The radiotelemetry techniques were also applied to monitoring Wild Turkey (*Meleagris gallopavo*) to better understand habitat use during brood-raising in a fire-maintained landscape (Sisson et al. 1991) and mortality rates of poults (Peoples et al. 1995).

The arrival of Leonard Brennan as research director of Tall Timbers in 1993 brought Tall Timbers into the national debate over long-term declines of the Northern Bobwhite throughout its range



Figure 12. Research Director Leonard Brennan at gathering in front of Beadel House, about 2000. Photograph courtesy of Tall Timbers Research Station.

(Brennan 1994; Figure 12). Outright elimination of habitat through urbanization and changing methods in agriculture (e.g., use of herbicides/pesticides, the loss of weedy edges and hedgerows) and forestry (e.g., high-density pine plantations) and reduction in use of prescribed fire were identified as the main reasons for decline at the regional level. Brennan and his graduate students also brought two themes of Tall Timbers ornithological research together in his studies that showed that quail benefited when habitat restoration was applied for Red-cockaded Woodpecker management (Brennan et al. 1995, Fuller 1994). Brennan left Tall Timbers in 2001; he went on to the Caesar Kleberg Wildlife Research Institute in Kingsville, Texas, and Texas A&M University as a Professor and Endowed Chair for Quail Research. Ron E. Masters was hired as Research Director at Tall Timbers in 2002.

William E. Palmer, hired in 1997 as the Tall Timbers game bird biologist, became the liaison between Tall Timbers and Red Hills landowners on game management issues and developed a large-scale research program on bobwhite in the Red Hills (Figure 13). Palmer and

his technicians and graduate students studied such traditional game management techniques as the efficacy of supplemental feeding to improve bobwhite productivity and the influence of predators on bobwhite nest success (Staller et al. 2005). This study of predation was subsequently expanded into an ongoing 6-year removal experiment to test the effects of mammalian mesopredators on bobwhite recruitment. Wellendorf et al. (2004) found that the number of adjacent quail coveys was the variable that most influenced the probability of bobwhites in a covey calling. Use of covey calls to estimate abundance is best done during the peak calling period in good weather conditions. Addressing a question of conservation importance, Palmer found that nutrition may be depressing productivity of bobwhite found nesting in areas of native ground cover.



Figure 13. William Palmer, R. C. Balfour Game Management Research Fellow at Tall Timbers in 2004. Photograph courtesy of Tall Timbers Research Station.

Most recently, Tall Timbers researchers have used micro-satellite DNA to determine bobwhite covey composition and parental investment in offspring. This represents the next generation of technology following radiotelemetry. Other ongoing studies include the response of small mammal and quail populations to the scale of management, particularly prescribed fire, how insect populations, and hence the prey base for bobwhite quail, are influenced by genetically modified cotton agriculture, the affects of snake communities on bobwhite quail populations, and how ranchland management in south Florida can be modified to increase bobwhite populations. This last study may have implications for conservation of these rangelands, which would affect many native plants and animals of Florida.

BIRDS AND FIRE

NB66: A fire exclusion experiment.—The early philosophy of Tall Timbers was to conduct long-term research; the first projects were planned for minimal 100-yr study periods (Komarek 1977:41). NB66 was designed to document plant and animal community succession on an annually-burned pine ridge after fire exclusion. It was to test Kurz's (1944) prediction that without fire a Red Hills pineland would result in a closed-canopy hardwood forest.

In 1966 original investigators Andre Clewell and Roy Komarek (plants) and W. Wilson Baker (birds, small mammals) had an 8.6-ha study site surveyed into 30 x 60-m subplots. The ridge was oldfield pine (loblolly, *Pinus taeda*; and shortleaf, *P. echinata*), but very old; core borings dated one tree to 1861, and living memory at the time traced annual burning to at least 1935, but the practice dated almost certainly before the beginning of the 20th century. After an initial inventory, the plot was burned one last time on 23 March 1967 and called NB66 (i.e., not burned since the winter season of 1966-1967).

Breeding birds in NB66 were censused by spot-mapping (Williams 1936) annually 1967-1981 by Baker and later Robert L. Crawford. Engstrom et al. (1984) presented the first 15 years of bird data and quantitative vegetation data from thirty 0.04-ha circular samples. Landers and Crawford (1995) added five more years of bird data and summarized that the NB66 study:

“ . . . demonstrated the tremendous importance of habitat structure to birds. NB66 changed over the [first 15] years from an open, mostly pine forest (about 45 trees/acre [ca 111 trees/ha]) to a low, thick hardwood forest (840 trees/acre [ca 2076 trees/ha]) with scattered tall pines. The original luxuriant ground growth was shaded out by the low canopy and replaced with dead litter. Open habitat birds such as [Northern] Bobwhite, Loggerhead Shrike [*Lanius ludovicianus*], Eastern Kingbird [*Tyrannus tyrannus*], Blue Grosbeak [*Guiraca caerulea*], and Indigo Bunting [*Passerina cyanea*] either left immediately or disappeared after a few years of sharp declines. A low shrub layer developed in the plot for a short interval that attracted or enhanced a few species (Prairie Warbler [*Dendroica discolor*], Yellow-breasted Chat [*Icteria virens*], White-eyed Vireo [*Vireo griseus*]) but they, too were excluded, or virtually so, after the shrubs grew up into small trees. During the latter portion of the first 15 years, a new set of birds moved onto the plot, species usually associated with mature hardwood forests in bottomlands. Wood Thrushes [*Hylocichla mustelina*], Acadian Flycatchers [*Empidonax virescens*], Red-eyed Vireos [*Vireo olivaceus*], Hooded Warblers [*Wilsonia citrina*], and Kentucky Warblers [*Oporornis formosus*] were recorded with increasing frequency.”

By 2006 NB66 had stabilized into a young hardwood forest with an open floor (Figures 14a and b). One by one the large pines are dying and with no recruitment, they will eventually disappear. When they fall, ephemeral light-gap tangles occur, creating brief habitat for White-eyed Vireos. Breeding bird censuses continue in NB66, although not on an annual schedule. It seems that the most dramatic changes are now in the past.

Apalachicola National Forest experiments.—In the 1990s the season of fire in ecological management of the longleaf pine ecosystem became an important subject for research. The idea was that the growing season (May to August) was the season when lightning-started fires



Figure 14. Comparison photographs from the same point of NB66 in (a, top) 1966 and (b, bottom) 2003 (Engstrom et al. 1984). Photograph credits: Roy Komarek and R. Todd Engstrom.

occurred naturally, therefore prescribed fire would best mimic nature through application during the appropriate season. Traditionally, most prescribed fire in the north Florida-south Georgia region was applied in the dormant season from January through April, when cooler temperatures, lower humidity, and steadier winds facilitated controlled burning. A 4-year experiment was conducted on eight 12-ha study plots to measure the effects of growing season versus dormant season biennial fire on the breeding bird and winter bird populations in longleaf pine forests. The breeding bird community exhibited no dramatic response to season of fire (Engstrom et al. 1996b). During this same study McNair (1998) observed both Henslow's Sparrow (*Ammodramus henslowii*) and Sedge Wren (*Cistothorus platensis*) take refuge in titi (*Cyrilla racemiflora*) in

a narrow wet depression in front of a slowly advancing dormant season fire.

Pine woods birds studies.—The roots of Tall Timbers are in Stoddard's study of the ecology of the Northern Bobwhite, which is typically found in the southeastern United States in open, pine-dominated woodlands. Fire enables pines to thrive in these forests, and the longleaf pine-wiregrass (*Aristida stricta*) is the keystone ecosystem of the southeastern coastal plains and is dependent on frequent fires. Because of their habitat affinities and geographic distribution three bird species are most clearly associated with the longleaf pine ecosystem: the Red-cockaded Woodpecker, the Brown-headed Nuthatch (*Sitta pusilla*), and the Bachman's Sparrow (*Aimophila aestivalis*) (Engstrom 1993).

Red-cockaded Woodpecker studies.—In *The Birds of Grady County* which summarized his local ornithological observations over a period of four-and-a-half decades, Herbert Stoddard said of the Red-cockaded Woodpecker: "Probably no Southeastern bird offers richer reward for detailed life history studies, because interesting peculiarities of its habits and ecological requirements and preferences are many" (Stoddard 1978:76). Stoddard encouraged W. Wilson Baker, who arrived at Tall Timbers as a staff member in 1966, to conduct studies of the woodpecker. Baker established a research program at Tall Timbers on Red-cockaded Woodpecker life history, that included cavity tree characteristics, interspecific use of cavities, roosting behavior, helpers at the nest, territory size, and foods (Baker 1971a,b; Figure 15). Further, Baker marked all woodpecker cavity trees on the 1138-ha station grounds and conducted annual status checks of each cavity tree cluster from 1971 to 1983 (Baker 1983). Unfortunately, the year 1970 was the high water mark for the woodpecker population at Tall Timbers when 40 individuals and 11 nests were found. The population slowly declined thereafter until its extirpation in 1981 (Baker 1983). Reduced immigration, decreased tree suitability as the old-field pines aged, and changes in forest structure and composition all might have contributed to the demise of the species at the research station. Since the breeding population disappeared, single individuals have periodically been observed at the station, but no bird has taken up residence.

In the summer of 2006 Jim Cox, Greg Hagan, and Joshua McCormick began excavating 40 artificial cavities (using techniques



Figure 15. Herbert L. Stoddard (left) and W. Wilson Baker on Stoddard's 80th birthday, 24 February 1969. Photograph credit: Gary Doster.

described in Copeyon 1990, and Allen 1991) in 10 clusters on Tall Timbers in anticipation of a translocation attempt that fall of Red-cockaded Woodpeckers captured in nearby colonies. The birds, nine juvenile woodpeckers (5 males; 4 females) were taken from nine separate family groups on three plantations to enhance the potential genetic diversity of this founding population. Most of the birds moved that first year left, but not all. In the spring of 2007, Cox and McCormick found one pair of Red-cockaded Woodpeckers using some of these artificial cavities and a single male using another of the artificial cavities at another location. On 10 June 2007 they banded two nestlings, the first to hatch on Tall Timbers since 1981.

In the fall of 2007, they moved four more pairs to Tall Timbers, and

in 2008 they had three successful nests and were able to band six young. In 2008, 10 more recruitment clusters (40 additional cavities) were created and that summer the Tall Timbers Red-cockaded Woodpecker population consisted of four pairs and two single males. A major development was noted by Cox on 18 September 2008: one of the transplanted males on Tall Timbers had initiated a start hole, the first known attempt to create a natural cavity by one of the transplanted birds.

Based on his knowledge of the life history of the species, Stoddard (1978) expected the Red-cockaded Woodpecker to become rarer as short-rotation forestry became more widespread throughout the Southeast. Sadly, this prediction was fulfilled when the species was listed as endangered in 1970. Tall Timbers, through the efforts of W. W. Baker, played a seminal role in conservation of the species by co-hosting the first symposium on the species in 1971 in Folkston, Georgia (Thompson 1971). Baker provided crucial statewide population status summaries of the woodpecker in both Florida (Baker et al. 1980) and Georgia (Baker 1981, Ozier et al. 2004) before the U.S. Fish and Wildlife Service galvanized its conservation efforts.

At a local level, Stoddard observed that although the Red-cockaded Woodpecker was becoming scarce in surrounding counties, the species was "more numerous [in the Red Hills] than in any part of the Southeast" (Stoddard 1978:75). He attributed this observation to the fact that, "some 300,000 acres of the immediate region is in large, private game preserves, where the forests are kept in an open condition by means of controlled burning for the purpose of quail and Wild Turkey production." Stoddard's forestry consulting practice in the Red Hills had control over management of most of the land with woodpecker populations. His procedure was to "not remove old trees until evidence of decline became serious. [He] usually left intact the occupied nesting trees of the Red-cockaded Woodpecker, often with the hearty approval of the forest owners." After Stoddard's death his associate and partner, Leon Neel, continued their consultancy, using a methodology known locally as the Stoddard-Neel method. Its core technique entailed annual fires and individually inspecting and selecting trees for harvest instead of clear cutting whole blocks (Engstrom et al. 1996a). Under Neel's supervision the Red Hills successfully supported the largest population of Red-cockaded Woodpeckers on private land (Engstrom and Baker 1995).

Currently, the Red Hills Ecological Stewardship Consortium, composed of representatives from Tall Timbers, the Georgia Department of Natural Resources, the Florida Fish and Wildlife Conservation Commission, and the U.S. Fish and Wildlife Service, is working toward a comprehensive conservation plan for the Red-cockaded Woodpecker in the Red Hills. The primary conservation tool, in addition to conservation easements, is Safe Harbor agreements in which a landowner and a government agency establish a baseline population for a property for which the landowner is responsible.

During the Consortium's efforts in 2002-2007, Safe Harbor properties in the Red Hills rose to 21, encompassing 25,000 ha that included 121 active and 65 inactive Red-cockaded Woodpecker territories. Enrolled properties conserved habitat for approximately 63% of the active territories in the Red Hills. Presently, the Red Hills Safe Harbors area has increased to about 40,500 ha.

Most importantly, the woodpecker population increased. The surveys by Tall Timbers biologists in 1992 and 1998 noted a steady number of about 180 active colonies. Excavation of some 175 artificial cavities and the translocation of 24 juveniles to new or inactive clusters resulted in a Red Hills population of 190 active territories by 2008, well on the way to the Consortium's long-term goal of 200.

Brown-headed Nuthatch studies.—Recognizing the close association between the Brown-headed Nuthatch and fire-maintained pine forests, Jim Cox has conducted a program to band a significant portion of the nuthatch population (over 185 adults and 250 nestlings had been banded by 2006) on Tall Timbers to better understand its life history. Like the Red-cockaded Woodpecker, this species exhibits helping behavior. Based on nest monitoring, annual nesting success varies from 20 to 60% and is most affected fire and reptilian and mammalian predators. Natal dispersal for males, based on a limited sample size, has been <2 territories, which indicates that any helping at nearby nests may be with related individuals (Figure 16). Some notable differences in nest height and helping behavior exist between the Tall Timbers population and a well-studied population in south Florida's Big Cypress Swamp (Cox and Slater 2007). Cox's and Slater's paper won the Edwards prize for the best paper published in Volume 119 (2007) of *The Wilson Journal of Ornithology*.



Figure 16. Jim Cox with a Red-cockaded Woodpecker at the Wade Tract, about 2002. Photograph courtesy of Jim Cox.

Bachman's Sparrow studies.—One of the most difficult-to-study species in the longleaf pine ecosystem is the Bachman's Sparrow, because of its cryptic coloration and elusive behavior. Clark Jones and Jim Cox have color-banded over 250 individuals to study movement patterns and productivity in relation to application of prescribed fire. About half the sparrows remained on their territories following the application of growing season fire. Also, family groups of sparrows seem to move back onto recently burned patches perhaps for improved foraging ability.

Cox's experiences with the nuthatch and sparrow, two fire-dependent pine woods birds, led him to collaborate with Brent Widener to publish in 2008 "Lightning-season burning: friend or foe of breeding birds?" This booklet addresses season of burn affects (late winter or growing season) on several species of birds of management concern, including bobwhite, Wild Turkey, Brown-headed Nuthatch, and Bachman's Sparrow.

TALL TIMBERS INTO THE TWENTY-FIRST CENTURY

When Prentiss Baldwin started banding sparrows and talking to his hunting friends in south Georgia about their quail problems, he initiated an intellectual stirring among the local naturalists. They brought in Stoddard and the Komareks, who by way of the WCTV-Tower project, established the small research station mainly to study the role of fire in ecosystems. Stoddard had demonstrated fire's crucial function in the Northern Bobwhite's life history, which made the local landowners supportive of further fire research. Meanwhile, an awareness of the unique Red Hills ecosystem (with large populations of quail and Red-cockaded Woodpeckers), and a wariness of encroaching development, encouraged Tall Timbers to become a leader in land conservation. Since 2005, its official name has been Tall Timbers Research Station & Land Conservancy. Since 1958 Tall Timbers has evolved from a small, inconspicuous entity doing pure research on fire ecology and associated birds, into a prominent, well-known institution still partly dedicated to the study of fire ecology and avifauna (especially quail), but also now with at least half its effort dedicated to land conservation; protecting local old-growth forests and pristine waterways is its prime concern. Throughout this nearly 100-year continuum of shifting emphases, fire and quail have been the constant threads.

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LITERATURE CITED

- Allen, D. H. 1991. An insert technique for constructing artificial Red-cockaded Woodpecker cavities. U.S. Department of Agriculture, Forest Service General Technical Report SE-73.
- Baker, W. W. 1971a. Progress report on life history studies of the Red-cockaded Woodpecker at Tall Timbers Research Station. Pp. 44-59 in R. L.

- Thompson, ed., Proceedings of a Symposium on the Ecology and Management of the Red-cockaded Woodpecker, U.S. Bureau of Sport Fisheries and Wildlife and Tall Timbers Research Station, Tallahassee, Florida.
- Baker, W. W. 1971b. Observations on the food habits of the Red-cockaded Woodpecker. Pp. 100-107 in R. L. Thompson, ed., Proceedings of a Symposium on the Ecology and Management of the Red-cockaded Woodpecker, U.S. Bureau of Sport Fisheries and Wildlife and Tall Timbers Research Station, Tallahassee, Florida.
- Baker, W. W. 1981. The distribution, status, and future of the Red-cockaded Woodpecker in Georgia. Pp. 82-87 in R. R. Odom and J. W. Guthrie, eds., Proceedings of the Nongame and Endangered Wildlife Symposium, Georgia Department of Natural Resources, Game and Fish Division, Technical Bulletin WL-5.
- Baker, W. W. 1983. Decline and extirpation of a population of Red-cockaded Woodpeckers in northwest Florida. Pp. 44-45 in D. A. Wood, ed., Red-cockaded Woodpecker Symposium II. Florida Game and Fresh Water Fish Commission, Tallahassee.
- Baker, W. W., R. L. Thompson, and R. T. Engstrom. 1980. The distribution of Red-cockaded Woodpecker colonies in Florida. *Florida Field Naturalist* 8:41-45.
- Baldwin, S. P. 1919. Bird banding by means of systematic trapping. *Proceedings of the Linnaean Society of New York* 31:23-56.
- Baldwin, S. P. 1921. Recent returns from trapping and banding birds. *Auk* 38:228-237.
- Baldwin, S. P. 1922. Adventures in bird-banding in 1921. *Auk* 39:210-225.
- Baldwin, S. P. 1925. Notes from S. Prentiss Baldwin. *Wilson Bulletin* 37:98-100.
- Baldwin, S. P., H. C. Oberholser, and L. G. Worley. 1931. Measurements of birds. Scientific Publications of the Cleveland Museum of Natural History Vol. II.
- Beadel, H. L. 1939. Hawks vs. quail on quail preserves. *Journal of Wildlife Management* 3:42-45.
- Beadel, H. L., and H. L. Stoddard. 1939. Marbled Godwit on the Gulf coast of Florida in summer. *Auk* 56:76.
- Brennan, L. A. 1994. Broad-scale declines in four species of North American quail: an examination of possible causes. Pp. 44-50 in W. W. Covington and L. F. DeBano, eds., Sustainable Ecological Systems: Implementing an Ecological Approach to Land Management. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-247.
- Brennan, L. A., J. L. Cooper, K. E. Lucas, B. D. Leopold, and G. A. Hurst. 1995. Assessing the influence of Red-cockaded Woodpecker colony site management on non-target forest vertebrates in loblolly pine forests of Mississippi: study design and preliminary results. Pp. 309-319 in D. L. Kulhavy, R. G. Hooper, and R. Costa, eds., Red-cockaded Woodpecker Symposium III: Recovery, Ecology, and Management. Center for Applied Studies in Forestry, College of Forestry, Stephen F. Austin State University, Nacogdoches, Texas.

- Brueckheimer, W. R. 1982. The quail plantations of the Thomasville-Tallahassee-Albany regions. *Proceedings of the Tall Timbers Ecology and Management Conference* 16:141-165.
- Bryan, D. C. 1981. Territoriality and pair bonding in the Limpkin (*Aramus guarauna*). M.S. thesis, Florida State University, Tallahassee.
- Burleigh, T. D. 1958. Georgia birds. University of Oklahoma Press, Norman.
- Chapin, C. M., III. 1980. Quail plantations: needs and problems. *Tall Timbers Quail Management Seminar Proceedings* 1980:19-23.
- Copeyon, C. K. 1990. A technique for constructing cavities for the Red-cockaded Woodpecker. *Wildlife Society Bulletin* 18:303-311.
- Cox, J., and R. T. Engstrom. 2001. The effects of spatial patterns of conservation lands on the persistence of a large population of Red-cockaded Woodpeckers. *Biological Conservation* 100:137-150.
- Cox, J., and G. Slater. 2007. Cooperative breeding in the Brown-headed Nuthatch. *Wilson Journal of Ornithology* 119:1-8.
- Cox, J., and B. Widener. 2008. Lightning-season burning: friend or foe of breeding birds? *Miscellaneous Publications of the Tall Timbers Research Station* no. 17.
- Crawford, R. L. 1974a. Bird casualties at a Leon County, Florida TV tower: October 1966-September 1973. *Bulletin of Tall Timbers Research Station* 18:1-27.
- Crawford, R. L. 1974b. Noteworthy Georgia specimens in the Tall Timbers Research Station collection. *Oriole* 39:37-42.
- Crawford, R. L. 1981a. Bird casualties at a Leon County, Florida TV tower: a 25-year migration study. *Bulletin of Tall Timbers Research Station* 22:1-30.
- Crawford, R. L. 1981b. Weather, migration and autumn bird kills at a north Florida TV tower. *Wilson Bulletin* 93:189-195.
- Crawford, R. L. 2004. The great effort: Herbert L. Stoddard and the WCTV tower study. *Tall Timbers Research Station Miscellaneous Publication* 14.
- Crawford, R. L., and R. T. Engstrom. 2001. Characteristics of avian mortality at a north Florida television tower: a 29-year study. *Journal of Field Ornithology* 72:380-388.
- Davidson, W. R., F. E. Kellogg, G. L. Doster, and C. T. Moore. 1991. Ecology of helminth parasitism in bobwhites from northern Florida. *Journal of Wildlife Diseases* 27:185-205.
- Dimmick, R. W., F. E. Kellogg, and G. L. Doster. 1982. Estimating bobwhite population size by direct counts and the Lincoln Index. Pp. 13-18 *in* *Proceedings of the 2nd National Bobwhite Quail Symposium*. Environment Series no. 6, Oklahoma State University, Stillwater, Oklahoma.
- Engstrom, R. T. 1979. Plot size as a factor in avian censuses. M.S. thesis, Florida State University, Tallahassee.
- Engstrom, R. T. 1993. Characteristic birds and mammals of longleaf pine forest. *Tall Timbers Fire Ecology Conference* 18:127-138.
- Engstrom, R. T., and W. W. Baker. 1995. Red-cockaded Woodpeckers on Red Hills hunting plantations: inventory, management and conservation. Pp. 489-493 *in* D. L. Kulhavy, R. G. Hooper, and R. Costa, eds., *Red-cockaded Woodpecker: Recovery, Ecology, and Management*. Center for Applied Studies, College of Forestry, Stephen F. Austin State University, Nacogdoches, Texas.

- Engstrom, R. T., L. A. Brennan, W. L. Neel, R. M. Farrar, S. T. Lindeman, W. K. Moser, and S. M. Hermann. 1996a. Silvicultural practices and Red-cockaded Woodpecker management: a reply to Rudolph and Conner. *Wildlife Society Bulletin* 24:334-338.
- Engstrom, R. T., R. L. Crawford, and W. W. Baker. 1984. Breeding bird populations in relation to changing forest structure following fire exclusion: a 15-year study. *Wilson Bulletin* 96:437-450.
- Engstrom, R. T., D. B. McNair, L. A. Brennan, C. L. Hardy, and L. W. Burger. 1996b. Influence of dormant versus lightning season prescribed fire on birds in longleaf pine forests: experimental design and preliminary results. *Transactions of the 61st North American Wildlife and Natural Resources Conference* (1996):200-207.
- Fuller, R. S. 1994. Relationships between Northern Bobwhite habitat use and forest stands managed for Red-cockaded Woodpeckers at Noxubee National Wildlife Refuge. M.S. thesis, Mississippi State University, Mississippi State.
- Graves, G. R. 1993. A new intergeneric wood warbler hybrid (*Parula americana* x *Dendroica coronata*) (Aves:Fringillidae). *Proceedings of the Biological Society of Washington* 106:402-409.
- Greene, E. R. 1960. A lifetime with the birds. Privately printed by the author.
- Greene, E. R., W. W. Griffin, E. P. Odum, H. L. Stoddard, and I. R. Tompkins. 1945. Birds of Georgia, a preliminary check-list and bibliography of Georgia ornithology. Georgia Ornithological Society Occasional Publication no. 2.
- Greenlaw, J. S., and R. T. Engstrom. 2001. First record of Spotted Towhee in Florida. *Florida Field Naturalist* 29:26-28.
- Gromme, O. J. 1973. In memoriam: Herbert Lee Stoddard. *Auk* 90:870-876.
- Johnston, D. W. 1967. The identification of autumnal Indigo Buntings. *Bird-Banding* 38:211-214.
- Johnston, D. W. 1968. Body characteristics of Palm Warblers following an overwater flight. *Auk* 85:13-18.
- Johnston, D. W. 1974. Decline of DDT residues in migratory songbirds. *Science* 186:841-842.
- Kellogg, F. E., and G. L. Doster. 1972. Diseases and parasites of the bobwhite. Pp. 233-276 in *Proceedings of the 1st National Bobwhite Quail Symposium*, Oklahoma State University, Stillwater.
- Kellogg, F. E., G. L. Doster, W. R. Davidson, and W. M. Martin. 1982. Efficiency of dogs in locating bobwhites. Pp. 31-34 in *Proceedings of the 2nd National Bobwhite Quail Symposium*, Environment Series no. 6, Oklahoma State University, Stillwater.
- Kellogg, F. E., G. L. Doster, and L. L. Williamson. 1970. A bobwhite density greater than one bird per acre. *Journal of Wildlife Management* 34:464-466.
- Kellogg, F. E., and A. K. Prestwood. 1968. Gastrointestinal helminthes from wild and pen-raised bobwhites. *Journal of Wildlife Management* 32:468-475.
- Kendeigh, S. C. 1940. In memoriam: Samuel Prentiss Baldwin. *Auk* 57:1-12.
- Komarek, E. V., Sr. 1977. A quest for ecological understanding: the Secretary's Review. *Miscellaneous Publications of Tall Timbers Research Station* no. 5.

- Komarek, E. V., Sr. 1982. The role of the hunting plantation in the development of game, fire ecology and management. Tall Timbers Ecology and Management Conference 16:167-187.
- Kurz, H. 1944. Secondary forest succession in the Tallahassee red hills. Proceedings of the Florida Academy of Sciences 7:59-100.
- Landers, L., and R. L. Crawford. 1995. NB66: a study of habitat relations of nongame birds and mammals in seres of oldfield pinewoods following fire exclusion. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program, Project Report GFC-84-004.
- Lowery, G. H., Jr. 1951. A quantitative study of the nocturnal migration of birds. University of Kansas Publications, Museum of Natural History 3:361-472.
- Marshall, S. G., and V. B. Baker. 1964. University of Georgia studies on the role of fat in bird migration. Oriole 29:35-39.
- McAtee, W. L., T. D. Burleigh, G. H. Lowery, Jr., and H. L. Stoddard. 1944. Eastward migration through the Gulf states. Wilson Bulletin 56:152-160.
- McNair, D. B. 1998. Henslow's Sparrow and Sedge Wren response to a dormant season prescribed burn in a pine savanna. Florida Field Naturalist 26:46-47.
- Means, D. B. 1980. Quail research at Tall Timbers: rising to the challenge. Tall Timbers Quail Management Seminar Proceedings 1980:28-31.
- Mueller, B. S. 1985. An evaluation of releasing pen-raised quail in the spring. Pp. 51-62 in R. W. Weeks and F. M. Long, eds., Fifth International Conference on Wildlife Biotelemetry, University of Wyoming, Laramie.
- Mueller, B. S., and J. Atkinson. 1985. First year report: post-fire mortality study. Pp. 4-9 in J. L. Landers, B. S. Mueller, and J. B. Atkinson, eds., Tall Timbers Game Bird Seminar Proceedings. Tall Timbers Research Station, Tallahassee, Florida.
- Musselman, T. E. 1923. Bird banding at Thomasville, Ga., 1923. Auk 40:442-452.
- Norris, R. A. 1963. A preliminary study of avian blood groups with special reference to the Passeriformes. Bulletin of Tall Timbers Research Station 4:1-71.
- Odum, E. P., C. E. Connell, and H. L. Stoddard. 1961. Flight energy and estimated flight ranges of some migratory birds. Auk 78:515-527.
- Ozier, J. C., W. W. Baker, and P. B. Spivey. 2004. Status and management of the Red-cockaded Woodpecker in Georgia: emphasis on private lands. Pp. 238-244 in R. Costa and S.J. Daniels, eds., Fourth Red-cockaded Woodpecker Symposium: Road to Recovery. Hancock House, Surrey, British Columbia, Canada.
- Paisley, C. 1989. The Red Hills of Florida, 1528-1865. University of Alabama Press, Tuscaloosa.
- Peoples, J. C., D. C. Sisson, and D. W. Speake. 1995. Mortality of Wild Turkey poults in coastal plain pine forests. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 49:448-453.
- Pollock, K. H., C. T. Moore, W. R. Davidson, F. E. Kellogg, and G. L. Doster. 1989. Survival rates of bobwhite quail based on band recovery analyses. Journal of Wildlife Management 53:1-6.
- Powell, M. C. 1997. In memoriam: Samuel A. Grimes, 1906-1996. Auk 114:753.

- Robertson, W. B., and G. E. Woolfenden. 1992. Florida bird species: an annotated list. Florida Ornithological Society Special Publication no. 6.
- Rogers, W. W. 1989. Foshalee: Quail Country Plantation, with an overview of Leon County, Florida, and Thomas County, Georgia. Sentry Press, Tallahassee, Florida.
- Shields, L. J., R. Darling, and B. S. Mueller. 1982. A telemetry system for monitoring bobwhite quail activity. Pp. 112-115 in *Proceedings of the Seventh International Symposium on Biotelemetry*, Stanford, California.
- Shields, L. J., and B. S. Mueller. 1983. An alternative radio-transmitter attachment technique for small birds. Pp. 57-62 in *Proceedings of the Fourth International Wildlife Biotelemetry Conference*. Halifax, Nova Scotia, Canada.
- Sisson, D. C., D. W. Speake, and J. L. Landers. 1991. Wild Turkey brood habitat use in fire-type pine forests. *Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies* 45:49-57.
- Smith, G. F., F. E. Kellogg, G. L. Doster, and E. E. Provost. 1982. A 10-year study of bobwhite quail movement patterns. Pp. 35-44 in *Proceedings of the 2nd National Bobwhite Quail Symposium*, Environment Series no. 6. Oklahoma State University, Stillwater.
- Staller, E. L., W. E. Palmer, J. P. Carroll, R. P. Thornton, and D. C. Sisson. 2005. Identifying predators at Northern Bobwhite nests. *Journal of Wildlife Management* 69:124-132.
- Stevenson, H. M., and B. H. Anderson. 1994. *The birdlife of Florida*. University Press of Florida, Gainesville.
- Stoddard, H. L. 1931. *The Bobwhite Quail, its habits, preservation and increase*. Charles Scribner's Sons, New York.
- Stoddard, H. L. 1951. Bullock's and Baltimore orioles, *Icterus bullockii* and *galbula*, in southeast Georgia. *Auk* 68:108-110.
- Stoddard, H. L. 1962a. Use of fire in pine forests and game lands of the deep southeast. *Tall Timbers Fire Ecology Conference* 1:31-42.
- Stoddard, H. L. 1962b. Bird casualties at a Leon County, Florida TV tower, 1955-1961. *Bulletin of Tall Timbers Research Station* 1:1-94.
- Stoddard, H. L. 1969. *Memoirs of a naturalist*. University of Oklahoma Press, Norman.
- Stoddard, H. L. 1978. Birds of Grady County, Georgia. *Bulletin of Tall Timbers Research Station* 21:1-175.
- Stoddard, H. L., H. L. Beadel, and E. V. Komarek. 1961. *The Cooperative Quail Study Association*. Tall Timbers Miscellaneous Publications 1:1-500.
- Stoddard, H. L., and R. A. Norris. 1967. Bird casualties at a Leon County, Florida TV tower: an eleven-year study. *Bulletin of Tall Timbers Research Station* 8:1-104.
- Talbot, L. R. 1922. Bird-banding at Thomasville, Georgia, in 1922. *Auk* 39:334-350.
- Thompson, R. L. (ed.). 1971. *The ecology and management of the Red-cockaded Woodpecker*. Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior, and Tall Timbers Research Station, Tallahassee, Florida.
- Wamer, N. O. 1978. Avian diversity and habitat in Florida: an analysis of a peninsular diversity gradient. M.S. thesis, Florida State University, Tallahassee.

- Wellendorf, S. D., W. E. Palmer, and P. T. Bromley. 2004. Estimating calling rates of Northern Bobwhite coveys and measuring abundance. *Journal of Wildlife Management* 68:672-682.
- Weiser, C. E. 1973. A comparison of avifauna between an unpolluted marsh and a polluted marsh on the Gulf coast of Florida. M.S. thesis, Florida State University, Tallahassee.
- Wiese, J. H. 1975. The reproductive biology of the Great Egret *Casmerodius albus egretta* (Gmelin). M.S. thesis, Florida State University, Tallahassee.
- Williams, A. B. 1936. The composition and dynamics of a beech-maple climax community. *Ecological Monographs* 6:318-408.

History of Ornithology at Archbold Biological Station

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ABSTRACT. - In 1941 explorer Richard Archbold founded a field station in south-central Florida for the study of plants and animals in nature. The habitats at the Archbold Biological Station and surrounding landscape are oak scrub and flatwoods, with associated swales, seasonal ponds, bayheads, and one small lake, providing rich diversity of birds and habitats for study. The Station has excellent facilities for researchers, including laboratories and rooming accommodations. Nearby, the Station leases from the John D. and Catherine T. MacArthur Foundation a large working cattle ranch where ornithological research also occurs. From its inception Archbold Biological Station has attracted many field biologists including ornithologists. This chapter presents in chronological sequence the five persons primarily responsible for ornithological research at the Station: Richard Archbold, James Layne, Glen Woolfenden, John Fitzpatrick, and Reed Bowman. For each of these five "vectors" of ornithology we describe their ornithological activities throughout the state and in professional organizations while they were at the Station. We also review the work of visiting investigators and students who have done significant ornithological work at the Station. By far the most extensive and influential body of ornithological research at Archbold Biological Station is the long-term and multi-faceted study of the endangered Florida Scrub-Jay (*Aphelocoma coerulescens*), which began in 1969 and continues through the present. We summarize the history of this project in some detail.

FOUNDING OF ARCHBOLD BIOLOGICAL STATION

"When the taxonomic-faunistic researches began to suffer from the law of diminishing returns, it became evident that a field sta-

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³Deceased

tion is a far more effective tool for ecological and behavioral research than is an expedition.” E. Mayr (1975:378).

Richard Archbold (1907-1976, Figure 1) as a youth loved the outdoors and outdoor activities. As a teenager he attended three private schools, which he tolerated. The last of these, Evans School in Arizona, he enjoyed because camping was one of the activities that the school encouraged. At the family’s country home in Thomasville, Georgia, Richard was influenced by Herbert Stoddard, who lived nearby and was in charge of a research program to enhance populations of the Northern Bobwhite (*Colinus virginianus*). Stoddard’s research was supported by the local plantation owners, including Richard’s father John F. Archbold, who was an avid quail hunter. As he matured, Richard became a photographer, naturalist, explorer, world traveler, mountain climber, aviator, and patron of natural history studies. The financial independence that allowed Richard to accomplish these activities came via inheritance passed down through his father from his grandfather, John D. Archbold, who succeeded J. D. Rockefeller as president of Standard Oil of New Jersey (Moore 1930).

Following discussions with Leonard C. Sanford of the American Museum of Natural History (AMNH), Richard’s father agreed to finance the American contingent of a French-British-American zoological expedition to Madagascar. The agreement included accommodating Richard as a photographer and mammalogy assistant in the expedition. C. G. Harrold, a Canadian ornithologist, who was to represent the AMNH on the expedition, died shortly before the expedition was to depart. Professor Arthur A. Allen of Cornell University suggested Austin L. Rand (1905-1982), a graduate student at Cornell, as a replacement. Rand accepted the invitation, and the party set off for three years of exploration (1929-1931). During the expedition Archbold and Rand developed what was to be a close, life-long friendship. Rand was far more than a study-skin taxonomist interested in discovering new forms and producing more accurate distribution maps. He also had a strong desire to learn about the life histories of birds. His influence on Richard Archbold probably had much to do with the founding of Archbold Biological Station a decade later. Archbold learned of the unexpected death of his father while on the Madagascar expedition, and cut his trip short to return home. His personal passion for fostering and facilitating exploration, discovery, and scientific curiosity had been whetted.



Figure 1. Richard Archbold (1907-1976), founder of Archbold Biological Station, willingly assisted visiting scientists. Here he is steering a boat on the Caloosahatchee River on a bird collecting trip with Frank A. Hartman, 17 March 1945. Photograph by Leonard J. Brass.

With his inheritance, Richard Archbold established a foundation, Archbold Expeditions, dedicated to scientific exploration. From 1933 to 1939 he financed and helped lead three more expeditions, all to New Guinea (1933-34, 1936-37, 1938-39). Having become a skilled aviator, Archbold sought opportunity to use amphibious aircraft to reach previously unexplored regions of the Indo-Pacific. Ernst Mayr (1904-2005), who had recently returned from a collecting trip to New Guinea and joined the staff at the AMNH, suggested the focus on New Guinea and helped plan the first expedition led by Archbold and Rand. Although many collectors, including Charles B. Cory (Stoddard 1969), had con-

templated taking supplies from the coast to the mountainous interior of New Guinea by airplane, Archbold was the first to accomplish this feat. The fates of his two airships led to some harrowing adventures during the expeditions (Archbold and Rand 1940). A fourth expedition was planned for April 1940, but was canceled because of deteriorating global political conditions that soon led to World War II (Morse 2000). Great Britain's Royal Air Force took ownership of Archbold's storied PBY flying boat (the "Guba") for four year's service during WW2 on coastal patrols and on transport service to Gibraltar and West Africa (Tate 1946).

Cancellation of the fourth New Guinea expedition resulted in Archbold developing a plan to set up a temporary biological field station in the United States in order to keep the Archbold Expeditions team together (Rand 1941, 1976). Arizona, near Tucson, was a preferred site and temporary headquarters were established at the Tanque Verde Ranch. Richard had lived in this area as a schoolboy, which made him especially eager to choose this site. Having little to explore, the team soon shifted its emphasis from collecting specimens to learning about the life histories of the local fauna. Rand (1941) no doubt played a major role in this shift of emphasis.

Key to establishing Archbold Biological Station in Florida was a lingering friendship between Richard and his schoolmate, Donald Roebling, also from a wealthy family. The Roebling family business was manufacture of steel cable and construction of cable-suspension bridges (including the Brooklyn Bridge). Richard learned from Donald about Red Hill Estate, near Lake Placid, Florida, where Donald's parents, John and Margaret Shippen Roebling, had built (1930-31) a massive warehouse alongside a railroad track in preparation for building a new home in a natural setting. After Margaret's death, John's interest in the property waned, and he began offering it to various organizations for construction of a hospital or as a teaching institution, but nothing materialized. Archbold visited Red Hill and was impressed with the possibilities offered by both the facilities and the natural habitats. On 21 July 1941, the 428-ha (1,058-acre) Red Hill property, including its buildings, was deeded to Richard Archbold for the sum of one dollar.

The physical plant at Red Hill was self contained and first rate. It had its own power generator and water purification plant. It included a 284,000 liter (75,000-gallon) elevated water storage tank, a 10-car

garage, and a fire engine. Key to establishing facilities where field biologists could work was a magnificent 103.6 X 12.2-m (340 X 40-foot) concrete warehouse and dwelling building (Figure 2), which easily could withstand any weather that Florida hurricane seasons could muster. This building included four upstairs rooms that could accommodate about ten overnight visitors. Soon after acquisition, Archbold made significant changes to accommodate more visitors. He built six cottages,



Figure 2. Main Building at Archbold Biological Station, with the view to the west showing the Station's Tract 7, the heart of the scrub-jay demography tract, with its habitat mosaic of periodically-burned oak scrub knolls, pine flatwoods, and seasonal ponds, summer 1986. This building originally was a Roebling warehouse along a railroad siding (on the west side), but now is occupied (starting at the north) by the multi-purpose classroom and multi-user lab; the library and computer center; the plant ecology lab; the entomology lab; the vertebrate lab (now restoration ecology lab); the bird lab; and the combination of education office, chemistry lab, and photography darkroom. The two-story unit at the south end contains dormitories and five offices upstairs; and the dining room, kitchen, lounge, and two offices downstairs. Photographed from the 90-foot water storage tank by Paige Martin.

doubled the size of the garage, and added a dining room and a roof over the east porch of the main building. The main building had seven storage bays. Archbold converted four bays into laboratories, and a fifth was partially converted to accommodate a business office and a growing library. The two remaining bays supported carpentry and mechanical shops, staffed by Archbold's nimble and capable technical engineer, Bob Nagle. Archbold Biological Station now was ready for research.

From its founding in 1941 until 31 December 1981 the Station was operated as a unit of the AMNH, funded by an endowment from Archbold Expeditions Foundation and by Archbold himself. The Department of Mammalogy at the Museum also received support from these sources. From a few years after Archbold's death through the present, the Station has operated as an autonomous unit of Archbold Expeditions, now a not-for-profit organization overseen by a board of trustees that still includes a number of Archbold family members (Layne 1983a). As of this writing, the Chairperson of this board is still Richard Archbold's sister, Frances Archbold Hufty (1912-), who shares many of her brother's passions and visits the Station almost weekly from her home in Palm Beach, Florida.

Like many patrons of natural history, Richard Archbold's name is enshrined in the scientific names of numerous animals (40 species). Most of these are arthropods (30 species) and most pertain to specimens found at the Station in recent years. Earlier, during expedition times, seven birds received the Archbold epithet: *Accipiter nanus [archboldi]* Stresemann, *Aegotheles [albertisi] archboldi* Rand, *Archboldia [papuensis] papuensis* Rand, *Dacelo [Sauromarptis] tyro archboldi* Rand, *Eurostopodus [Lyncornois] archboldi* Mayr and Rand, *Newtonia archboldi* Delacour and Berlioz, and *Petroica archboldi* Rand (Lohrer 1999).

Almost all centers for ornithological research exist at one of three types of institutions: universities, natural history museums, or field stations and observatories. All three places must have personnel, and museums always include specimen collections. At some field stations the personnel are few and part time, and many lack collections. Virtually all field stations offer stewardship of, and access to, natural lands, often facilitating maintenance of long-term databases pertaining to this land. Archbold Biological Station has all of these resources in full representation: a full-time staff including professional scientists, excellent reference collections of plants and animals, and ownership of

superb natural landscape managed under the direction of the scientific staff for purposes of research and conservation. The mission statement (formally adopted in 1989) describes the activities of the Station throughout its existence (Fitzpatrick 1991:1):

“Archbold Biological Station is dedicated to long-term ecological research and conservation. The primary focus is on the organisms and environments of the unique Lake Wales Ridge and adjacent central Florida. The Station’s program is part of a global effort to understand, interpret, and preserve the earth’s natural diversity.”

ARCHBOLD BIOLOGICAL STATION FACILITIES

Archbold Biological Station is suitable for a wide variety of studies of birds, primarily because the Station and its parent foundation preserve a large and remarkable piece of the native landscape of central Florida. Situated 13 km (8 mi) south of the town of Lake Placid at the south end of the Lake Wales Ridge, Archbold Expeditions owns 3578 ha (8841 acres) of contiguous property (Figure 3). This tract consists of two main segments: one segment, which comprises 2102 ha (5193 acres) accumulated since 1941, is natural oak scrub, pine flatwoods, swales, bayheads (Abrahamson et al. 1984), and the 36-ha (90-acre) Lake Annie; the other segment is cattle pastureland and wetlands, currently under restoration, comprising 1476 ha (3648 acres) purchased in 2002, which is known as “the Archbold Reserve.” Adding to the effective size of the native habitats of the Archbold property is a contiguous tract of 1659 ha (4100 acres) of native scrub, owned and managed by the Florida Fish and Wildlife Conservation Commission since 1993, which lies along the north and west boundaries of the Station, reaching and broadly bordering the south shore of Lake Placid. This provides significant additional habitat available for Archbold-based scientists to study. Three small satellite properties border nearby lakes Istokpoga, Placid, and Henry. About 13 km (8 miles) east of the main property, and off the Lake Wales Ridge, the Station leases and manages a 4249-ha (10,500-acre) cattle ranch from the John D. and Catherine T. MacArthur Foundation. Station personnel and visiting investigators conduct research in conservation biology and agro-ecology at this ranch.

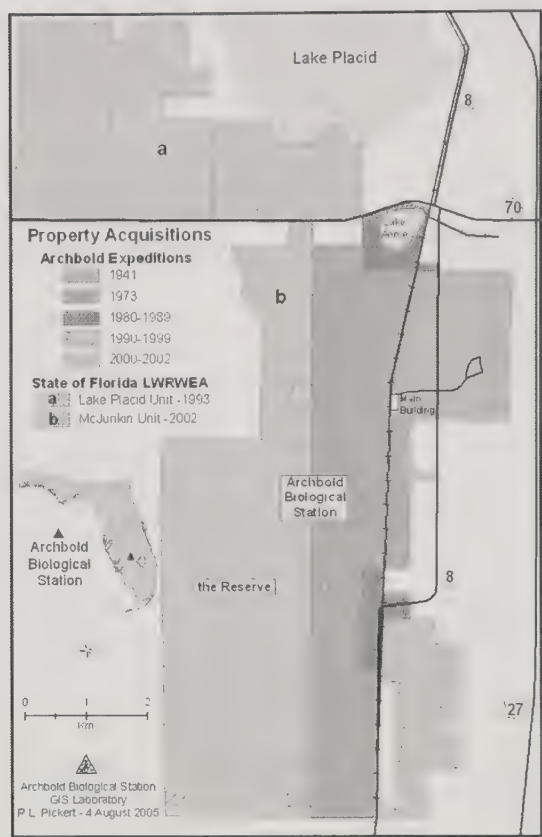


Figure 3. Boundary map of Archbold Biological Station, showing the chronology of property acquisitions and the surrounding Florida state preserves. Map by Roberta L. Pickert.

Facilities on the main Archbold property include the large laboratory building and nine cabins, each with full kitchen facilities. The Station serves meals in a dining room attached to the laboratory building. The Station maintains an extensive library that is especially strong in periodicals and books related to ecology and evolution, natural history of Florida, vertebrate biology (including ornithology), and entomology. The serials holdings at the Station are listed online, and an online catalogue of books is being prepared. The library houses an excellent collection of maps and aerial photographs, with emphasis on central Florida. The Station maintains an outstanding geographic information

system (GIS) including extensive coverages of local topography, soil, habitat, fire history, and research data.

Lists of birds identified on the Archbold Biological Station (Lohrer and Woolfenden 1992) and at the MacArthur Agro-ecology Research Center (MAERC) (McMillian and Yosef 2001) are available at the Station's Web site <www.archbold-station.org>. A list of the birds reported from Highlands County has been published (Lohrer et al. 1987). A reference collection of bird specimens (about 1500 bird skins and 525 bird skeletons) is housed at the Station. For most species these specimens consist of a few examples of each that were taken in Florida. At present about three-quarters of the bird species known from Florida are represented in the study skin collection, including a large number of Florida state rarities. For the Florida Scrub-Jay and a few other species, large research series of specimens have accumulated. Specimen collections also exist for plants, arthropods, fishes, amphibians, reptiles, and mammals.

Other literature and materials of use to ornithologists are available at the Station. For birds these include bird-banding records, nest records, winter bird counts, and daily bird-record sheets. Related ecological information includes 75 years of climatological data, hydrological records, 35 years of fire history (entirely digitized into the GIS database), vegetation maps, historical aerial photos, and species lists (plants, invertebrates, vertebrates).

Archbold Biological Station's Web site (<http://www.archbold-station.org>) contains much additional information about the Station's facilities, ecosystems, and publications. The scientific bibliography includes 1650 titles published during 1942-2006. Ornithological publications account for about one-quarter of this productivity. Of 140 theses and dissertations based on work done at the Station, 30 percent pertain to birds, of which 75 percent pertain to the Florida Scrub-Jay.

FIVE VECTORS OF ORNITHOLOGY AT ARCHBOLD BIOLOGICAL STATION

The history of ornithology at Archbold Biological Station can be envisioned as a series of overlapping "vectors." This term is used here in the context of a force, influence, or directional component of motion. Over the Station's first 68 years, influences of Richard Archbold, Jim

Layne, Glen Woolfenden, John Fitzpatrick, and Reed Bowman represent overlapping eras of ornithologists and their researches.

Richard Archbold vector (1941-1976): The early years.— Richard Archbold was 34 years old when he established Archbold Biological Station. “Mr. A.” (a semi-formal and affectionate name coined by Woolfenden, who just could not call Richard Archbold “Dick”; Figure 4) resided at the south end of the main building and became Resident Director, a position he held throughout his life, and took seriously. Two rooms upstairs and a lounge on the main floor next to the kitchen were his personal domain. In these rather Spartan quarters, and also in his beloved electronics lab, he resided for 35 years until 1 August 1976 when he died of pancreatic cancer. For about 25 years after the Station’s

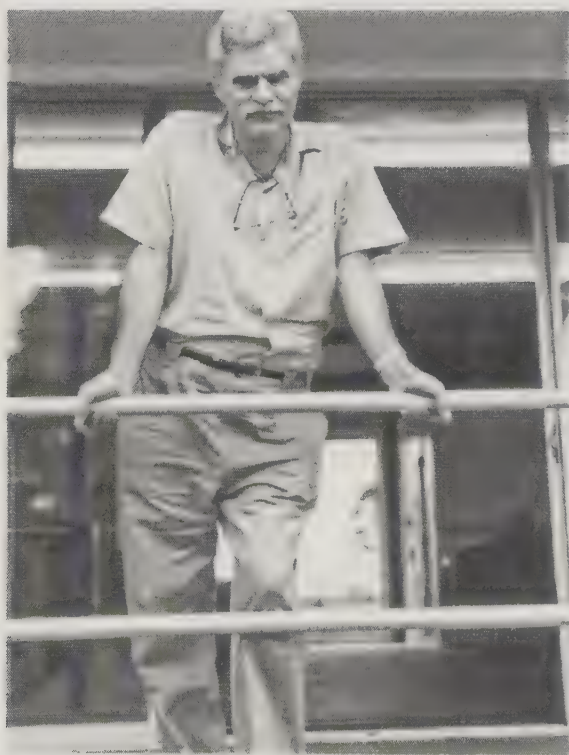


Figure 4. Richard Archbold (1907-1976), founder and Resident Director (1941-1976) of Archbold Biological Station, in his usual attire of khakis, on the ramp of the Main Building, June 1966. Photograph by James A. Wagner.

inception, ornithological studies (and all other research) were conducted primarily by visiting scientists. Early on, the Station was available only to staff members of the AMNH. In December 1944 an announcement in *Science* (Brass 1944) stated that the facility was now open to a limited number of approved investigators from other institutions. An impressive group of scientists began using the Station. Entomology probably was best represented among the visitors, but numerous ornithologists began to appear at Archbold's door. The following is an annotated account of some of the more renowned ornithologists who used Archbold Biological Station as a base for their investigations in the 1940s, 1950s, and early 1960s.

Austin L. Rand (1905-1982; Figure 5), predictably, was the first ornithologist to work at the Station, starting in 1941. He published its first two bird papers (Rand 1942, 1943), including a note describing



Figure 5. Austin L. Rand (1905-1982), first Archbold Biological Station resident biologist (1941-1942), and lifetime friend of Richard Archbold, as photographed in Ottawa, Canada, 1946. Photograph courtesy of the National Museums of Canada, negative number 92,979.

predation on birds by largemouth bass (*Micropterus salmoides*). Rand departed the Station in February 1942 for a career position in his native country at the National Museum of Canada. In 1947 he moved to the Field Museum of Natural History in Chicago, where he remained until retirement in 1970. His distinguished career included serving as President of the American Ornithologists' Union, 1962-1964. Almost immediately after retirement he and his wife Rheua packed up and moved to a home they had purchased on Lake Huntley, near the town of Lake Placid and only about five miles from Archbold Biological Station. For several days each week, Austin would work at his desk in the Visitors Lab at the Station, and until Archbold's death in 1976, he regularly would lunch with his friend Dick. A three-page memoriam, which includes an excellent photograph (Traylor et al. 1984), provides additional details of Rand's illustrious career.

Dean Amadon (1912-2003; Figure 6), who obtained a Ph.D. from Cornell University, joined the Department of Ornithology at the AMNH in 1937, and chaired that department from 1957 to 1973. In a tribute to Amadon at his retirement, Lester Short stated that Dean developed a milieu of "quiet scholarship amid a friendly climate that has maximized research productivity of staff and visitors" at the museum (Lanyon 1995:127). Shortly after the founding of Archbold Biological Station, Robert Cushman Murphy suggested to Amadon that he conduct some research at the Station. Dean first visited in 1943 from 27 March to 29 April, during which time he gathered field observations that he reported in "A preliminary life history study of the Florida Jay, *Cyanocitta c. coerulescens*" (Amadon 1944a). This is the third publication on birds from the Station (Archbold library archives), and foreshadowed the substantial research on this signature species at the Station beginning in the late 1960s. A note comparing the weights of three bird species based on representatives from Florida (Archbold Biological Station) and localities farther north soon followed (Amadon 1944b), and some years later he published a preliminary list of the birds of the Station (Amadon 1956). During his long career at the AMNH, Dean authored over 400 publications. His greatest interest toward the end of his career was diurnal birds of prey, which culminated in a coauthored two-volume tome. Dean Amadon served on the advisory board of Archbold Expeditions from 1955 to 1981, and on the Station's Scientific Advisory Board from 1985 to 1989. He conducted some of his writing projects on raptors dur-

ing his annual winter visits to the Station, and also participated in several roadside bird censuses organized by Jim Layne (see next vector). Dean received many honors and served as President of the American Ornithologists' Union (1964-1966). Through 1990, when his wife, Tavy, became house bound, Dean was a regular winter visitor to the Station.

Ernst Mayr (1904-2005; Figure 6), the world renowned ornithologist, evolutionary biologist, and historian of science, played an important, if indirect, role in the establishment of Archbold Biological Station. Mayr joined the ornithology department at the AMNH in 1931 (and would become Dean Amadon's mentor). Mayr advised Archbold during preparations for the first New Guinea expedition. In the fall of 1931, Mayr accompanied Archbold on a trip to the family plantation, Chinkapin, near Thomasville, Georgia, where they met with Herbert Stoddard. After the establishment of the Station in 1941, Ernst, some-



Figure 6. Dean Amadon (1912-2003), left, and Ernst Mayr (1904-2005), right, with Glen E. Woolfenden, as photographed in the Director's Cottage (Palmetto Cottage), 1987 or 1988, by James L. Wolfe.

times with his wife Gretel, made regular winter visits to the Station through 2002. During these visits, which often were up to a month long, Mayr wrote or dictated first-draft prose for several of his many books.

A number of other ornithologists occasionally used Archbold Biological Station between 1945 and the early 1960s. Arthur A. Allen, Cornell University, visited to conduct studies of the Swallow-tailed Kite (*Elanoides forficatus*). Oliver L. Austin, Jr., University of Florida, initiated plans to band birds, and especially Florida Scrub-Jays, and to collect specimens locally. Lincoln Brower, Jane Van Zandt Brower, and R. P. Coppinger used birds at the Station, especially Blue Jays (*Cyanocitta cristata*) and Florida Scrub-Jays, as butterfly predators for their famous studies of mimicry. Their classic cover-photograph in *Science* of a Blue Jay regurgitating a distasteful butterfly was taken in flight cages at the Station (Brower et al. 1968). Frank A. Hartman, Ohio State University, an outstanding endocrinologist and authority on adrenal glands, published 18 papers on birds, most of them on adrenals and related glands, and some on cardiac and pectoral muscle weights, and lipids in the liver and locomotor muscles of birds. With assistance from Mr. Archbold, Hartman collected birds in south Florida, which he dissected at the Station (Hartman 1961). Richard F. Johnston, University of Kansas, used the Station as a base for preliminary research in the early 1960s on the Common Ground-Dove (*Columbina passerina*) and White-crowned Pigeon (*Columba leucocephala*; Johnston 1964). Lawrence Kilham, Dartmouth Medical School, a visiting investigator during several decades from the early 1950s to the late 1980s, conducted field work on woodpeckers at the Station (Kilham 1983) and on American Crows (*Corvus brachyrhynchos*) near the Station (Kilham 1989a). Although somewhat peripheral to ornithology, Lawrence R. Penner, University of Connecticut, came to the Station for many years to conduct his studies of avian schistosomiasis and other bird parasites (Penner and Fried 1963, Penner and Trimble 1970). Knut Schmidt-Nielsen, Duke University, conducted some of his early research on the function of salt glands at the Station in the late 1950s (Schmidt-Nielsen and Fang 1958). Robert K. Selander, University of Texas, used the Station as a base for some of his studies of grackles (genus *Quiscalus*). Charles G. Sibley, of Yale University and previously at Cornell University, visited in the 1950s and 1960s to use the Station as a base for collecting egg-white proteins and blood samples. Henry M. Stevenson, from Florida State

University, used Archbold as a base for conducting breeding bird censuses and studies of grackles (Stevenson 1978). The 1966-1967 Annual Report from Archbold Biological Station to the AMNH (Archbold 1967: 4) includes an intriguing note: "July 11, 1966. Mr. C. Russell Mason, Florida Audubon Society, visited with Mr. Archbold to discuss the possibility of obtaining land in this area for the purpose of a sanctuary for the Florida scrub jay."

Jim Layne vector (1967-): Building a modern research center.—James N. Layne (1926- ; Figure 7), who obtained the Ph.D. degree under William J. Hamilton at Cornell University, and later taught at Southern Illinois University, the University of Florida, and Cornell, was hired by Richard Archbold to be the Station's first official director of research on 1 June 1967. Jim had visited the Station numerous times over the preceding decades to study its mammals. After Richard Archbold's death in 1976, Layne was named the Station's first executive director. He held this position until 1985, at which time he resumed a full-time research position and James L. Wolfe (a former Ph.D. student of Layne's) was appointed executive director (1985-1988). Jim Layne continued as a senior research biologist at the Station until 1993, and continues to visit the Station as an emeritus biologist through the present.

During his tenure as executive director, Jim Layne literally converted Archbold Biological Station into a modern field research facility. He vastly improved the physical plant by converting the workshop bays of the main building into modern research laboratories, upgrading the various service rooms, renovating the visitor cabins, and adding a machine shop building. He purchased many pieces of field equipment needed for research, including a fleet of field vehicles, and helped acquire additional land, most notably the area that includes the pristine Lake Annie. Jim Layne understood the timeless importance of gathering and archiving long-term data, and he established many monitoring programs that continue to provide critical data for all investigators.

For most of his life Jim Layne has been a naturalist in the finest sense of the word. His naturalist's curiosity has focused on the biology of vertebrates. Jim's first report to the AMNH following his arrival at the Station outlined ambitious research plans to define and describe the habitats of the Station (Abrahamson et al. 1984), and to document the



Figure 7. James N. Layne, Archbold Biological Station's director of research (1967-1976) and executive director (1976-1985), with a fledgling Crested Caracara (*Caracara plancus*), a species whose breeding biology and population ecology he studied for several decades, 14 May 1974. Photograph by Linda V. Layne.

distribution, seasonal occurrences, populations, ecology, and life histories of the amphibian, reptile, bird, and mammal faunas of the Station (Archbold and Layne 1968:5). Jim concentrated his own investigations on mammals, especially rodents. His studies of the scrub-endemic Florida mouse (*Peromyscus floridanus*) and related species in the genus *Peromyscus* are of world renown.

As a youth Jim became interested in falconry, and he never abandoned his interest in raptorial birds. Since coming to the Station he published papers on several raptors, especially on Cooper's Hawks (*Accipiter cooperii*) (Layne 1986), Crested Caracaras (*Caracara plan-*

cus) (Layne 1982a, 1985, 1995, 1996) and American Kestrels (*Falco sparverius*) (Layne 1980, 1982d; Layne and Smith 1992), and also on Sandhill Cranes (*Grus canadensis*) (Layne 1981a,b, 1982b,c). In 1977, Layne headed a team of biologists to inventory the vertebrates of a seven-county area potentially affected adversely by Florida's growing phosphate mining industry (Layne et al. 1977). With help from Archbold staff, students, and visiting ornithologists, Layne conducted regional roadside bird censuses (waterbirds; raptors; Loggerhead Shrikes, *Lanius ludovicianus*) along 500 km of rural highways twice a year during 1974-1981, and four times during 1989-1992 (Yosef et al. 1993).

Two additions to the scientific staff made by Jim Layne early in his tenure were important to the study of birds at Archbold Biological Station. Chester E. Winegarner held the position of scientific assistant to Jim Layne from April 1968 until he retired in 1984. Chet's primary duties were to trap and mark mammals on the Station, to record data from these individuals, and to prepare specimens. Chet, assisted by Fred Lohrer, also conducted annual mast censuses for many years. Chet received a B.S. degree in zoology at the University of South Florida in 1968, where he worked extensively with Woolfenden. He participated in numerous bird censuses, in Sooty Tern (*Sterna fuscata*) banding trips to the Dry Tortugas, and in specimen preparation. He continued to assist in these ways when he moved to the Station where he became an on-site naturalist. Chet added much to our knowledge of the birds at the Station through reports and specimen records. He also became a devoted friend of Mr. Archbold, and Chet and his wife Marsha (Seigler) Winegarner (M.S. from University of South Florida under Layne) helped Mr. A. in many ways, especially during his terminal illness.

Fred E. Lohrer joined the staff at Archbold Station as a scientific assistant and librarian in June 1972. He became the librarian/information manager in 1988, and retired in 2005, to assume a part-time position as librarian in 2006. Fred received his M.S. from the University of South Florida in 1976, where Woolfenden was his major adviser. As an ornithologist, Fred has devoted an enormous amount of volunteer service to professional organizations. For the Florida Ornithological Society, among many other positions, Fred, a charter member, served as editor of the *Florida Field Naturalist* (1976-1981) and president (1993-1995). On the national and international levels, Fred served as director of Ornithological Societies of North America

(OSNA; 1991-1998). For the American Ornithologists' Union he has been a member of several standing committees, served as associate editor of *The Auk* responsible for the Recent Ornithological Literature (1983-1990), and was elected a fellow of the AOU in 1994. Fred has published several local breeding bird censuses and winter bird population studies, plus numerous notes on the behavior of local birds. Fred has enormous wealth of knowledge of the literature in ornithology and Florida ecology, and is of extraordinary help for investigators working at the Station, especially those interested in birds.

In 1982, financial independence from the AMNH allowed Archbold Biological Station to add senior professional staff. An invertebrate ecologist, Mark A. Deyrup, and a plant ecologist, Ronald S. Myers, were hired that year. In 1988, Myers moved to The Nature Conservancy where he became their chief fire ecologist. His position at the Station was filled by Eric S. Menges, a globally recognized plant demographer, who concentrates on rare and endangered species. Mark and Eric continue at the Station through this writing, actively publishing their own research and providing vital information to students and visitors of all ilks, including ornithologists.

The following ornithologists first worked at Archbold Biological Station during the Jim Layne vector. John T. Emlen, University of Wisconsin, used the Station as a base for his comparisons of land-bird densities on the Florida peninsula and the Bahamas (Emlen 1978, 1980). Erma J. Fiske resided on the Station (Dec-Apr 1979-1980) for netting, trapping, and banding birds in various habitats on the Station, during which time 430 individuals of 39 species were processed. Michael Kinsella, a parasitologist, worked on the endoparasites of Florida Scrub-Jays as a postdoctoral fellow at the Station (Kinsella 1974). Stanley A. Temple, University of Wisconsin, directed graduate student Michael P. Wallace who in 1979-1980 experimented with techniques for rearing and releasing Black and Turkey vultures (*Coragyps atratus* and *Cathartes aura*) as a pilot study for similar work about to begin with California Condors (*Gymnogyps californianus*; Wallace and Temple 1983). Woolfenden began his work at the Station soon after Jim Layne arrived (see below). Graduate student Lilian Saul studied Red-bellied Woodpecker (*Melanerpes carolinus*) behavior directed by Lester L. Short of the AMNH (Saul 1983, Saul and Wassmer 1983).

Jim Layne directed eight graduate students who worked on mammal projects, and one who worked with birds. David R. Smith studied

sex ratios and habitat preferences of wintering American Kestrels at and near Archbold Biological Station (Smith 1988).

James L. Wolfe was director of Archbold Biological Station from 1985-1988. During his brief stay, Wolfe made the pivotal decision to construct an annex to the main building with matching funds from the National Science Foundation. This provided much-needed offices, an auditorium, space for the fluid collections of vertebrates, and (later) space for a Geographic Information System (GIS).

Glen Woolfenden vector (1969-2007): Florida Scrub-Jay era.—Woolfenden's vector at Archbold Biological Station began in 1969 (Figure 8) and thus overlapped all executive directors since the Station's founding. Moreover, as the first active, internationally involved, and gregarious professional ornithologist who based his major research program there, Woolfenden deserves credit for making the Station a leading field laboratory for the study of birds. (Both subsequent vectors, Fitzpatrick and Bowman, owe their beginnings at Archbold to Glen.) Woolfenden received a B.S. degree in 1953 from Cornell University, where he met Jim Layne. During summers he worked at the AMNH, where he worked under the tutelage of Dean Amadon. After receiving a M.S. degree in 1956 from the University of Kansas, where he worked under Harrison B. Tordoff, and a Ph.D. in 1960 from the University of Florida, directed by Pierce Brodkorb, he joined the faculty of the Department of Biology at the new University of South Florida (USF) in Tampa, where he served for forty years (1960-1999). He first visited the Station in November 1967, in part to rekindle his friendship with Jim Layne. At USF Woolfenden initially studied waterfowl osteology and systematics, research that began with his dissertation. Seeking a field project, he determined that – unlike farther north in North America – in certain woodland habitats on the Florida peninsula both bird diversity and bird density were greater during winter than during breeding (Woolfenden et al. 1967, 1968a,b; Rohwer and Woolfenden 1969). Seeking explanations either in features of habitats or in the habitats' geographic history, Woolfenden set out to conduct breeding-season and winter-season bird censuses in various parts of Florida peninsula. Archbold Biological Station seemed perfect for such comparisons, and Jim Layne was enthusiastic. But the project was not to last. After completing two sets of breeding and one set of winter censuses (Woolfenden 1969, 1970), some of which included Florida Scrub-Jays, Woolfenden



Figure 8. Glen E. Woolfenden, research biologist emeritus, in the Bird Lab, July 2000. Photograph by Jack P. Hailman.

switched and began to focus his studies on this intriguing, and still little-studied bird. He used the phrase “educated serendipity” to explain the reason for the switch (see “History of the Florida Scrub-Jay Project,” below).

Woolfenden was promoted to the distinguished position of graduate research professor at the University of South Florida, where he directed some 25 graduate students, 12 of whom worked on scrub-jays at Archbold. He served the American Ornithologists’ Union in numerous capacities, including president (1989-1990). Woolfenden, together

with John Fitzpatrick (see below) received the AOU's William Brewster Award for their book summarizing life history and evolution of cooperative breeding in the Florida Scrub-Jay (Woolfenden and Fitzpatrick 1984, Anonymous 1986). For his long-term studies of this species at Archbold Biological Station, Woolfenden also received the Margaret Morse Nice Award from the Wilson Ornithological Society (2001) and the Distinguished Animal Behaviorist Award from the Animal Behavior Society (1994). He was made a corresponding fellow of the Deutsche-Ornithologen Gesellschaft (1989), and a member of the International Ornithological Committee (1978-2007). He was a charter and honorary member of the Florida Ornithological Society, and served that society in several ways including as president (1991-1992). Woolfenden retired from USF in 1999, and moved, with his wife Jan, to Lake Placid. He brought to the Station a sizable collection of bird specimens and an ornithological library of books and reprints.

Colleagues who worked at Archbold Biological Station with Woolfenden on the scrub-jay project are mentioned below under that project's history. Others worthy of mention worked with Glen on numerous additional aspects of Florida ornithology. William B. Robertson, Jr., a senior biologist at Everglades National Park, conducted long-term banding and monitoring of Sooty Terns at the Dry Tortugas from the mid-1960s through the 1980s. Woolfenden (and Chet Winegarner) assisted with this project in various ways for many years. Robertson was working on the account of the Sooty Tern for the *Birds of North America* series when he died. Woolfenden helped complete that project with Elizabeth A. Schreiber (Schreiber et al. 2002), widow of one of Woolfenden's Ph.D. students, Ralph W. Schreiber, the "pelican-man" who died young. Robertson and Woolfenden summarized historical and modern occurrences of bird species in Florida (Robertson and Woolfenden 1992), written during Robertson's increasingly frequent visits to the Station beginning in the late 1980s. They also wrote "The breeding birds of Florida part I: sources and post-settlement changes," which was published after Bill's death (Woolfenden and Robertson 2006). A memoriam to Bill Robertson following his death in 2000 includes an especially fine photograph of him (Woolfenden 2001). Wayne Hoffman, now retired from the National Audubon Society, and P. William Smith often visited the Station to work with Glen on projects about Florida birds. As examples, all three of them described the invasion of south Florida by Short-eared Owls (*Asio flammeus*) from the

West Indies (Hoffman et al. 1999), and Smith and Woolfenden (1995) commented on the status of the Northern Wheatear (*Oenanthe oenanthe*) in Florida. Curtis S. Adkisson, retired from Virginia Polytechnic Institute and State University, visits the Station regularly to continue his studies of caching behavior by Blue Jays. Jon S. Greenlaw, retired from Long Island University, carries on several research projects as a research volunteer at the Station. He and Woolfenden studied the winter distribution of Saltmarsh and Nelson's sparrows (*Ammodramus caudacuta* and *A. nelsoni*) based on museum specimens on loan to the Station, and Jon ably assists with the monthly Florida Scrub-Jay census through this writing.

John Fitzpatrick vector (1972-): *Expanding conservation research.*—"Fitz" (1951- ; Figure 9) first came to Archbold Biological Station in 1972, while Richard Archbold was still holding court during cocktail time and at the dinner table. The National Science Foundation was funding summer Undergraduate Research Participants (URP) to introduce college undergraduates to research. AMNH offered URP funds for use by Archbold Biological Station, which allowed Woolfenden to supervise two interns in 1972. Fitz, a student at Harvard University, spent summers of 1972 and 1973 studying intrafamilial dominance in Florida Scrub-Jays (Woolfenden and Fitzpatrick 1977). After Harvard, Fitzpatrick received his Ph.D. under John W. Terborgh at Princeton University, studying South American tyrannid flycatchers. Fitz then moved to the Field Museum of Natural History as curator of birds and later as chairman of zoology. While in Chicago, he continued to work on both neotropical ornithology and Florida Scrub-Jays with Woolfenden at the Station. In 1988 he became the Station's third executive director, and moved to the Station early in 1989 with his wife, Molly, and their two young children. In 1995, Fitz departed to become director of the Cornell Laboratory of Ornithology, in Ithaca, New York. Throughout his time at Archbold Biological Station, Fitzpatrick served as chairman of the American Ornithologists' Union's Committee of Investing Trustees, and he was president of the AOU during 2000-2002. Fitz returns every spring during the jays' breeding season, focusing on field documentation of the annual map of all Florida Scrub-Jay territories in the Demography Tract and until Glen's death, to work with him on analyses and writing.

As executive director of Archbold Biological Station, Fitzpatrick expanded the Florida Scrub-Jay project and added new avenues of conservation-related research and action to the Station's repertoire. In 1988, while transitioning to the Station, he negotiated terms for a major grant from the Chicago-based John D. and Catherine T. MacArthur Foundation, whereby the Station received a dollar-a-year, 30-year lease to the Foundation's 4249-ha. (10,500-acre) Buck Island Ranch, an active cattle ranch 13 km (8 mi) east of the Station's main property, on the "Indian Prairie" northwest of Lake Okeechobee. With this grant the Station established MAERC, fostering study of the interactions among ranching, citrus production, and native landscape processes. At MAERC, Tom Bancroft conducted wading bird surveys and Mike McMillian studied the breeding raptors (especially Barred Owls, *Strix*



Figure 9. John W. Fitzpatrick, Archbold Biological Station's executive director (1988-1995), at the south end of the Main Building, August 1993, standing in front of what once was Richard Archbold's "home." Archbold's "Den" was through the door behind John's right shoulder and Archbold's bedroom was just above it. The Bird Lab is the second door north of the office sign. Photograph by Reed Bowman.

varia, and Red-shouldered Hawks, *Buteo lineatus*). At nearby Lake Istokpoga McMillian studied the largest breeding concentration of Ospreys (*Pandion haliaetus*) known in North America (Martell et al. 2004). Reuven Yosef, a Ph.D. student at Ohio State University, studied ecology of Loggerhead Shrikes (Yosef 1992a). Joan Morrison, a Ph.D. student at the University of Florida, studied life history and ecology of the Crested Caracara in the Kissimmee Prairie region while based at the MAERC (Morrison 1997). Now a professor at Trinity College, Morrison and her students continue this research. Bruce D. Dugger studied the waterbirds of the Kissimmee River floodplain (Dugger et al. 2005).

Fitzpatrick continued his predecessors' expansions of both the physical facilities and the land base of the Archbold Biological Station. He developed its first Geographic Information System (GIS) laboratory, enabling staff and visitors to build spatially explicit maps and databases into their research. Capitalizing on the Station's growing expertise and reputation in the ecology and biogeography of the Florida scrub ecosystem, Fitz spearheaded efforts that led to establishment of the Lake Wales Ridge National Wildlife Refuge and to the purchase of thousands of acres of natural habitat for long-term conservation management by local and state government. Many of these preserves serve as places for ornithological research on xeric upland ecosystems of Florida. During the early 1990s, Fitzpatrick regularly hosted Douglas Stotz, the late Theodore A. Parker, III, and Debra K. Moskovits at the Station, where this foursome completed a major book on ecology and conservation of neotropical birds (Stotz et al. 1996).

Fitzpatrick obtained the initial funding to hire Reed Bowman as leader of a team of researchers studying Florida Scrub-Jays in suburban settings, and studying both Florida Scrub-Jays and Red-cockaded Woodpeckers (*Picoides borealis*) at the Avon Park Air Force Range (APAFR). These projects are described under the Bowman vector. Fitz coordinated a two-year project (1992-93) involving numerous participants to make an exhaustive state-wide survey of the Florida Scrub-Jay, building on a similar project conducted alone ten years earlier by Jeff Cox as part of his Ph.D. dissertation at the University of Florida (Cox 1984, 1987). This statewide survey (Pranty et al. 1998), in turn, facilitated the first metapopulation analysis of the Florida Scrub-Jay (Stith et al. 1996) and an initial analysis of the genetic structure of Florida Scrub-Jays as compared with their close relatives in western North America

(McDonald et al. 1999). Genetic work on the Florida Scrub-Jay continues at Cornell, where Laura Stenzler conducted her M.S. research on scrub-jay genetics (Stenzler 2001, Stenzler and Fitzpatrick 2002) and then became the technician in the molecular laboratory of Irby Lovette at the Cornell Laboratory of Ornithology. Data gathered during an NSF-funded statewide genetic survey from 2004 through 2006 showed that the Florida Scrub-Jay is divided into about fourteen genetically separate subunits (Coulon et al. 2008).

While Fitz was Archbold Biological Station's director, the following individuals worked as staff or post-docs on various aspects of the Florida Scrub-Jay project: Reed Bowman (see below), Dirk Burhans, Robert Curry, David McDonald, and Bill Pranty. While working at the Station, Pranty authored *A Birder's Guide to Florida* (Pranty 1996). G. Thomas Bancroft, a former Woolfenden student who had studied molt in Florida Scrub-Jays and Blue Jays at Archbold for his M.S. (Bancroft 1982, Bancroft and Woolfenden 1982), joined the staff in 1994 as assistant director for MAERC. Bancroft moved to The Wilderness Society in 1997. As a visiting investigator, Calvin L. Cink, from Baker University (Baldwin City, Kansas), studied the winter ecology of Whip-poor-wills (*Caprimulgus vociferus*) and winter bird populations in two Station habitats (Cink and Lohrer 1990a,b). After Fitzpatrick moved to Cornell, he and Woolfenden obtained a 5-year National Science Foundation Long Term Research in Environmental Biology grant to continue the scrub-jay research. This allowed them to hire Artie Fleischer and later Larry Riopelle as field assistants. Larry continued working with the scrub-jays under grants received by Reed Bowman.

Reed Bowman vector (1992-): the future.—Reed Bowman (1958- ; Figure 10) received his Ph.D. in biology from USF under Woolfenden, studying White-crowned Pigeons in the Florida Keys (Bowman 1992). He joined the Archbold Biological Station staff in 1992 as a post-doctoral research associate, working on projects funded by grants and contracts. His position at the Station became permanent in 1994, when he was made assistant research biologist. Initially, Reed focused on Florida Scrub-Jays living in scrub habitat near the Station that steadily was being converted into a suburban housing development (Placid Lakes Estates). Bowman expanded his applied-ecology research team to include work on both Florida Scrub-Jays and Red-cockaded Woodpeckers on the APAFR, about 40 km (25 miles) northeast of the

Station. In 2002, a study of the Florida Grasshopper Sparrow (*Ammodramus savannarum*) at APAFR was added to the list. Reed was promoted to associate research biologist and named head of the Avian Ecology Laboratory at Archbold Biological Station in 2000. His work on the demography of suburban scrub-jays has led to a broader interest in urban ecology that, in 2001, resulted in a co-edited volume titled *Avian Ecology and Conservation in an Urbanizing World* (Marzluff et al. 2001). Reed is an active member of several ornithological societies, serving on the Student Awards and Research Awards (chair) Committees of the AOU. In 2005, he was named a fellow of the AOU and elected to its Council. For the Florida Ornithological Society he has served on several committees, including a seven-year stint as secretary

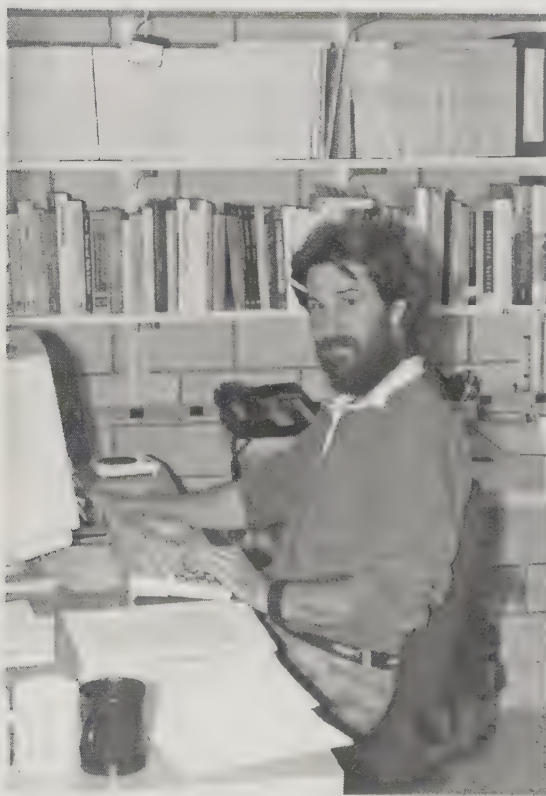


Figure 10. Reed Bowman, Archbold Biological Station associate research biologist and current head of the Bird Lab (2000-), 3 December 1994. Photograph by Nancy D. Deyrup.

of the Records Committee (1999-2005) and as president (1997-1999). Three students have received M.S. degrees from USF working with Reed on the scrub-jays at the Station for their theses: Arthur L. Fleischer (2000), Sonya C. LeClair (2005), and Matthew D. Shawkey (2001). Reed was co-chair of the committee of Annette Sauter (Ph.D., 2005), who worked on the suburban scrub-jays for her dissertation, at the University of Zurich. Recently, he has served on the committees of several students at University of Central Florida studying Florida Grasshopper Sparrows. Reed has had many research assistants over the years, working on scrub-jays and other species, including several post-doctoral students: David Aborn, Raoul Boughton, Ted Stevens, and James Tucker. At present, the Avian Ecology Lab has grown to five full-time research assistants and two post-docs, almost all supported from grants Reed has received. Visiting ornithologists Erica (Ricky) Dunn and David Hussell from Canada have spent parts of recent winter months at the Station. Mostly they worked on data collected elsewhere, but they also banded Eastern Towhees (*Pipilo erythrophthalmus*) and a few other species netted in an overgrown scrub site on the Station.

HISTORY OF THE FLORIDA SCRUB-JAY PROJECT

While conducting breeding-bird censuses at Archbold Biological Station in 1969, Woolfenden found nine Florida Scrub-Jay nests, and at six of these nests more than two adults were caring for the nestlings. Now “educated serendipity” came into play, as Woolfenden was familiar with the growing worldwide interest in cooperative breeding, especially through the work of the great naturalist Alexander Skutch (1935, 1961) and the Australian ornithologist Ian Rowley (1965). By serendipity, the birds he was censusing at the Station included a species that appeared to practice this behavior. Woolfenden knew that cooperative-breeding behavior still was poorly understood, and mostly was known in species that lived in faraway places (outside the north temperate parts of the world where most ornithologists lived). He found that scrub-jay nests were relatively easy to find, that they were built near the ground (and thus easy to check), and that the relatively open, scrub habitat allowed him to watch the birds from distances that would not disturb their behavior. Moreover, the scrub-jays at the Station were easily tamed, and the top of the “canopy” of their preferred habitat was below

the eye-level of many observers. Finally, the Station population not only occupied natural habitat, but this habitat was likely to remain protected indefinitely. As the Station was located within two hours' drive of USF, Woolfenden decided that this was the bird, and the place, for a long-term study of helpers-at-the-nest. This would prove to be a fruitful decision.

Woolfenden color-banded his first Florida Scrub-Jays in February, 1969. At the time, various incidental observers of scrub-jays at the Station had told him that "many scrub-jays have been banded at the Station and they were rarely seen again," that "scrub-jays do not defend territories," and that "having extra birds at the nests is an aberrancy to their normal behavior." His first year of field work proved all three of these opinions to be unjustified. He also discovered, to his consternation, that only a few pairs of scrub-jays lived on property owned by the Station (i.e., the original 428-ha (1058-acre) Red Hill property). "Mr. A." solved that problem in 1973 when he purchased an additional 1093 ha (2700 acres) of outstanding scrub habitat, mostly immediately west of the original property.

Prior to the work of Woolfenden and colleagues at the Station, few persons had studied the behavior of Florida Scrub-Jays. Sam Grimes (1940) published a photographic essay, and Dean Amadon (1944a) made a one-month study of unmarked individuals at the Station mentioned above. The first long-term study was by Peter W. Westcott, who began observing scrub-jays when he, along with Charles T. Collins, came to the Station in 1959 as undergraduate assistants of Lincoln and Jane Brower. Later Westcott extended his observations into a dissertation as a Ph.D. candidate under Pierce Brodkorb at the University of Florida (Westcott 1970). Westcott conducted his field work at Hicoria, a long-defunct sawmill "town" 3.2 km (2 miles) down the railroad tracks south of the Station. As the Station does not allow pets on the property, and Pete and his German shepherd dog were inseparable, he chose not to work on the scrub-jays that were common right around the Station's main building. Motivated in part by Woolfenden's study of scrub-jays at Archbold, Charlie Collins began conducting a long-term study of the Island Scrub-Jay (*Aphelocoma insularis*), a closely-related species restricted to Santa Cruz Island off the coast of mainland California (e.g., Collins and Cory 2005).

The study of Florida Scrub-Jays at Archbold Biological Station constitutes one of the longest continuous studies of a color-marked bird

population in the world, and almost certainly represents the longest one involving a species that does not nest in human-provided structures (e.g., tits in nest boxes). Key to the continuing success and ever-increasing breadth of this study have been the lead investigators' dedication to (1) banding all the birds occupying a sizable contiguous habitat tract, including immigrants as soon as possible after their arrival; (2) annual assembly of a team of professionals, assistants, volunteers, and interns to find and monitor all nests each spring; (3) conducting exhaustive censuses of the marked population every month, beginning in April, 1971; (4) detailed mapping of territory sizes and configurations via annual ground-truthing of every territorial boundary, and (5) keeping meticulously organized records (originally in a series of 3-ring notebooks, file folders, nest cards, and giant graph-paper sheets, then later in computerized, relational databases). Addition of GIS facilities at the Station during the 1990s allowed spatial registration of all the above data and their integration with vegetation maps and fire histories.

First results.—Woolfenden (1973) documented the chronology of breeding, details of nesting, and a few years' worth of reproductive success. He found that these tame, sedentary, monogamous birds have a narrow habitat tolerance for oak scrub, and he documented that they exhibit cooperative breeding. He found nests from February to June, but the scrub-jays mainly bred during a highly synchronous nesting season between mid-March and late May. Woolfenden reported that only the parents build nests, of oak twigs lined with scrub palmetto (*Sabal etonia*) fibers, into which two to five eggs are laid and incubated solely by the female breeder. Nesting success was slightly over 50% for first clutches, dropping to half or less than that for second and third (replacement) clutches. Offspring stayed with their parents on the natal territory, as pre-breeding "helpers" for their first year, although only about one third of the fledglings reach their first birthday. The youngest breeders he found were 2 years old, but many birds of this age and older continued to reside at home as helpers. Annual mortality of adult breeders was only about 20%, and over the short period of initial study, the study population appeared stable.

Woolfenden's (1975) report on the helper phenomenon included the first published color photograph (taken by Jim Layne in 1969) of a breeding pair plus a helper defending the nest. This study showed that helpers (Skutch's term) actually did help because pairs with helpers pro-

duced more offspring than those without. Both sexes helped in the first year (equal sex ratio) and older helpers were predominantly males. Cause and effect were difficult to disentangle, but it was clear that females dispersed earlier and farther than males. As most helpers were offspring of previous years, the helper system in this species fit an interpretation of kin selection. Nevertheless, Woolfenden put forth an alternative possibility, which would spark considerable debate in future years. He proposed that young scrub-jays deferred breeding and stayed at home for the perfectly selfish reason that doing so raises their own probability of becoming a breeder. This proposal would be formalized several years later (Woolfenden and Fitzpatrick 1978a,b, 1984; Fitzpatrick and Woolfenden 1986).

The value of observing marked birds was illustrated by Woolfenden's analysis of a rare case of bigamy (Woolfenden 1976b), which demonstrated the adaptive significance of having at least two adult scrub-jays attend each nest. Woolfenden (1978b) documented growth and survival of young scrub-jays, showing that eggs average 5.8 g at laying (7.6% of the female's body mass) and then lose 13% of their mass during incubation. Growth of nestlings and fledglings is slow, and young do not attain final adult body mass within their first year. Predation was the major cause of nest failure, and Woolfenden suggested that helpers may increase the reproductive success of the breeding pair more through nest defense than by feeding young. This paper won the Ernest P. Edwards prize of 1978 for the best paper published the preceding year in the *Wilson Bulletin*.

Enter Fitzpatrick.—Early in the study, as Woolfenden was establishing his basic field protocols and analyzing results for the above baseline reports, a vital collaboration for the scrub-jay project began. John W. Fitzpatrick came to the Station from Harvard in 1972 as an undergraduate summer intern; he bonded quickly with the study and the Station. For his study of dominance behavior he devised a simple instrument that delivered peanut bits only to the scrub-jay perched at a focal location. This study represents the first field experimentation in the budding scrub-jay project, and also cemented a personal and professional friendship that persisted between Woolfenden and Fitzpatrick. During that summer and the following one, through observations of natural encounters and via interactions at the peanut-bit feeder, Woolfenden and Fitzpatrick (1977) established that within family groups of Florida

Scrub-Jays, males dominate females, and within sexes breeders dominate helpers. Juveniles begin subordinate to everyone, but males quickly begin to dominate all females of the group including their mothers. Conveniently, during this period, Fitzpatrick had studied animal behavior at Harvard under visiting behaviorist, Bernard LeBeouf, and had spent considerable time with the noted sociobiologist Robert L. Trivers, for whom he had written a review paper on dominance behavior in social animals.

Fitzpatrick maintained his participation in the scrub-jay project throughout his period as a graduate student at Princeton University, where his dissertation research focused on behavior and morphology of South American tyrant flycatchers. Shortly after Fitzpatrick became curator of birds at the Field Museum of Natural History in Chicago, Woolfenden and Fitzpatrick (1978a) coined the term "territorial budding" to describe the process by which an offspring (almost always a son in the case of the Florida Scrub-Jay) takes over a part of the parental territory and becomes a breeder. The process is facilitated by the helpers themselves, because they help enlarge the territory and thereby create their potential breeding space. Brown (1978), who was studying the behavior of the closely related and cooperatively breeding Mexican Jay (*Aphelocoma ultramarina*), quickly criticized the paper, and Woolfenden and Fitzpatrick (1978b) fired back.

Publications and presentations by Woolfenden and Fitzpatrick began to stimulate invitations for talks, articles, and book chapters. Each ensuing contribution employed new data from their ongoing study to contribute in one or more of three ways: (1) to examine the biological context of some social or ecological question, beginning with the evolution of cooperative breeding but later expanding into other ecological and conservation arenas; (2) to synthesize results into new summaries or progress reports; or (3) to explain the Florida Scrub-Jay social system to general audiences. Woolfenden gave an invited talk at the 16th International Ornithological Congress, held in Canberra, Australia, reviewing cooperative breeding in American birds (Woolfenden 1976a). He also wrote an account of the Florida Scrub-Jay for a book on the rare and endangered avifauna of Florida (Woolfenden 1978a).

At the 17th International Ornithological Congress, held in West Berlin, Germany, Woolfenden and Fitzpatrick (1980) presented a paper under the paradoxical title: "The selfish behavior of avian altruists." During this period, kin-selection was flooding the literature to explain

much of social behavior; this prompted Woolfenden and Fitzpatrick to focus attention on ways in which seemingly unselfish behavior often could benefit the reputed altruist directly (see also Woolfenden 1981). As part of a series of invited commentaries on sociobiology, Fitzpatrick and Woolfenden (1981) made the general point that demography so drives social organization that one cannot effectively analyze the latter without thoroughly understanding the former. The early 1980s also brought further contributions to conservation issues (Woolfenden 1983) and articles for the general reader (Fitzpatrick and Woolfenden 1983, 1984).

"The book."—In 1979, with support from the National Geographic Society (Woolfenden and Fitzpatrick 1985a), and with Debra K. Moskovits as a field assistant, "the scrub-jay book" was begun. It appeared five years later (Woolfenden and Fitzpatrick 1984; Figure 11), synthesizing the results of the first 10 years of the Florida Scrub-Jay project. This monograph of more than 400 pages was drafted longhand (and its figures created by hand) during periodic visits by Fitzpatrick to Tampa or the Station, and by Woolfenden to Chicago. The volume is organized as ten stand-alone chapters covering a full range of basic natural history and demographic data, and used case-histories to illustrate various points. Ernst Mayr (in litt. to JPH, immediately after its publication) characterized the book as an "instant classic."

Rarely has a single scientific publication so thoroughly encapsulated a decade's history of ornithology at a single institution, while at the same time profoundly influencing its subsequent history. Although clearly not the sole ornithological activity during the 1970-1979 period, the scrub-jay project was the core endeavor and helped place Archbold Biological Station on the ornithological map worldwide. The book's early chapters describe what had to be done to create a project of this magnitude. A sense of the difficulties and time investment of the project is provided by the empirical chapters on pair bond, helpers, territory dispersal, reproduction, and survivorship. Year-by-year territory maps of Appendices B-K constitute a striking visual record of how the study population was continually expanded to encompass larger areas and more birds.

A major theme of the book is to show why the Florida Scrub-Jay is a cooperative breeder, in contrast with its close relatives in western U.S. The text is largely a detailed body of evidence showing that a species'



Figure 11. Three Florida Scrub-Jays (*Aphelocoma coerulescens*) at their nest. Two large nestlings (day 18) peer out from beneath their mother (left) and their half-sister (right). These two adults are defending from the photographers. The father has just arrived with food, the remains of a grasshopper. When the photograph was taken (11 May 1977) the mother was a minimum of 10 years old, the helper, her daughter, was 7 years old, and the father of the two nestlings was 3 years old. The nest, constructed of an outer basket of oak twigs and a lining of scrub palmetto (*Sabal etonia*) fibers, is in a sand live oak (*Quercus geminata*), the preferred substrate. This photograph occurs in “the book” (Woolfenden and Fitzpatrick 1984). Photograph by John W. Fitzpatrick and Glen E. Woolfenden.

habitat creates conditions that drive its demography, and the demography in turn drives the social structure. Non-breeders in a family group (the “helpers”) delay breeding, remain in their natal territory, and participate in sentinel watch for raptors, territorial defense, and feeding of fledglings. The striking absence of marginal-quality habitat produces a neighborhood saturated with breeding territories, hence the best option for pre-breeding jays is to remain in the family group, where the breeding pair (typically, their parents) benefits from the help.

The book demonstrated in detail that helpers benefit directly by gaining opportunities to become breeders while remaining in the safety of home. Male helpers are geographically positioned to detect the death of a nearby territorial male and compete for his territory, and female helpers have the same advantage in competing to become the replacement mate of a widowed male. Males also may inherit the home territory directly, or may “bud” from a home territory that had enlarged in part because he had helped it expand at the expense of neighbors. An underlying theme of the book — how helpers benefit from helping — sharply contrasted with the popular hypothesis that cooperative-breeding evolves principally via kin selection, the indirect fitness gained by facilitating reproduction of close relatives. The book’s Epilogue, written just prior to publication, described a massive 1979-1980 epidemic occurring after data analysis was complete, and emphasized that even ten years did not constitute a genuinely “long-term” study.

The 1980s and 1990s.—Publication outlets used by Archbold ornithologists shifted noticeably after the 1984 book, from contributed journal articles to chapters in books edited by others, technical reports, and meeting transactions, but always with emphasis on new empirical results. Papers by Woolfenden and Fitzpatrick from this period dealt with: growth of territories (Woolfenden and Fitzpatrick 1985b), demography (Woolfenden and Fitzpatrick 1985a), sexual asymmetries (Woolfenden and Fitzpatrick 1986), demographic routes to cooperative breeding (Fitzpatrick and Woolfenden 1986), components of lifetime reproductive success (Fitzpatrick and Woolfenden 1988, 1989), a synopsis after 18 years (Woolfenden and Fitzpatrick 1990), ecology and conservation (Woolfenden and Fitzpatrick 1991), population viability modeling (Fitzpatrick et al. 1991), and as a rare and endangered member of the Florida biota (Woolfenden and Fitzpatrick 1996a). Publications also continued to describe basic natural history observations, such as an account of a Florida Scrub-Jay foraging on the back of a white-tailed deer (*Odocoileus virginianus*; Fitzpatrick and Woolfenden 1996). The account by Woolfenden and Fitzpatrick (1996b) written for the *Birds of North America* project provided a thorough summary and review of Florida Scrub-Jay biology. During this period, two important volunteers, Barbara (“Bobby”) Kittleson and Janet Woolfenden, contributed many hours of field work and data compilation.

Early in the 1990s, Reed Bowman established two additional color-marked populations of Florida Scrub-Jays, each with characteristics that distinguished it from, and facilitate meaningful comparisons with, the scrub-jay populations at the Station. At Placid Lakes Estates, a subdivision 8 km (5 miles) north of the Station and joined to it by contiguous scrub, the scrub-jay population occurs in small patches of mostly overgrown scrub surrounded by encroaching suburban development. At Avon Park Air Force Range, the scrub also is patchily-distributed, but interspersed by a variety of natural (forests, wetlands, prairie) and man-modified habitats (pasture, planted pines). At both sites, the monitoring protocols are similar to those established by Woolfenden at the Station: all scrub-jays are banded, all nests are found, and periodic censuses of the entire populations are conducted. At APAFR work has focused on the effects of habitat fragmentation on dispersal (Fitzpatrick et al. 1999). At Placid Lakes Estates, work has focused on how the human-altered environment influences a suite of scrub-jay characteristics (Bowman 2003; Bowman and Woolfenden 2001, 2002; Fleischer et al. 2003; Sauter et al. 2006; Schoech and Bowman 2001, 2003; Shawkey et al. 2004) and the behavior of all birds (Thorington and Bowman 2003). To better understand the mechanisms by which urbanization causes differences in scrub-jay demography and behavior, these projects have increasingly used experimental manipulations of the scrub-jays in an "Experimental Tract" (see Mumme, below) at Archbold. With several grants from the National Science Foundation, Steve Schoech, now a senior collaborator, and Bowman have been investigating how food quality and availability influences scrub-jay reproduction and survival (Reynolds et al. 2003a,b).

Senior collaborators.—The scrub-jay study has attracted numerous colleagues. Jack P. Hailman first came to the Station in 1970 to visit his departmental colleague John T. Emlen, and they published a joint note from fieldwork near the Station (Hailman and Emlen 1985). Hailman began bringing undergraduate field courses to the Station during the 1970s, and became a regular member of the scrub-jay research team in 1979. Hailman worked at the Station annually since that year, and in 1999 became one of its few Research Associates. Several of his undergraduate students published short articles on field observations made in south Florida (not necessarily on Station grounds), and four graduate degrees (see below) were completed on behavioral studies of

the scrub-jays done at the Station under his direction. Hailman has since retired from the University of Wisconsin-Madison to live at Jupiter, Florida, and visits the Station regularly.

Ronald L. Mumme, a professor at Allegheny College (Meadville, Pennsylvania), received a B.A. degree in zoology from USF, and visited the Station on several occasions to help Woolfenden with scrub-jay field work. Mumme received his Ph.D. from the University of California at Berkeley where he studied under the tutelage of Frank Pitelka, author of the monograph on speciation and distribution of the genus *Aphelocoma* (Pitelka 1951). Mumme's dissertation research focused on the behavioral ecology of the cooperatively breeding Acorn Woodpecker (*Melanerpes formicivorus*). In 1986, on an NSF Fellowship in Environmental Biology, Mumme returned to the Station and helped establish a second color-banded population of scrub-jays, later referred to as the "Experimental Tract" to distinguish it from the adjacent "Demography Tract." Since then, virtually every scrub-jay on Archbold Biological Station (about 100-140 families) has been individually marked with plastic color bands. In the Experimental Tract some intrusive experiments are performed, although always of minor consequence to the population. Only experiments considered non-intrusive are conducted in the Demography Tract. Mumme's first research was designed to test, through removal experiments, the conclusion based on observational data that helpers help (Mumme 1992). Other projects have included determining methods for translocating scrub-jays to acceptable but vacant scrub (Mumme and Below 1999), and the effects of a high-speed road on demography of the scrub-jays (Mumme et al. 2000). Mumme now conducts ornithological field work in Costa Rica.

Stephan J. Schoech received his Ph.D. at the University of Washington under the direction of John C. Wingfield, working on endocrine mechanisms related to cooperative breeding in Florida Scrub-Jays (Schoech 1995). He began at the Station as a research assistant for Ron Mumme, later held a post-doctoral position at Indiana University with Ellen Ketterson, and then took a position on the faculty at the University of Memphis. Schoech established his own vigorous research program in the Experimental Tract directed broadly toward physiology, with focus on nutrition and endocrine factors causing or inhibiting reproduction (Schoech 1996, 1998; Schoech et al. 1991, 1996a,b, 1997). Schoech's expanding research at the Station is supported by several

NSF grants, and is now conducted in close collaboration with Reed Bowman.

Robert L. Curry, a professor at Villanova University, filled the postdoctoral position of a National Science Foundation grant awarded to Fitzpatrick and Woolfenden. In November 1990 he departed the Station for the faculty position he now holds, but has returned the Station to work on scrub-jay projects. Three of his graduate students have received M.S. degrees working on scrub-jays at the Station (see below).

James S. Quinn, McMaster University (Hamilton, Ontario), showed that genetic parentage matches social parentage among Florida Scrub-Jay offspring, research that was supported by an NSF grant to Fitzpatrick and Woolfenden and NSERC operating grants to Quinn and Bradley N. White (Quinn et al. 1999). Peter A. Bednekoff, Eastern Michigan University, worked with Woolfenden on details of the sentinel system associated with scrub-jay social behavior (Bednekoff and Woolfenden 2003, 2006). Marco Cucco, University of Eastern Piedmont (Alessandria, Italy), worked on mass fluctuation and regulation early in the breeding season. Hugh I. Ellis, University of San Diego, has been attempting to determine the field metabolic rates of Florida Scrub-Jays of different status during different times of the year and different parts of the annual cycle, and living in natural and suburban habitats. Jon Thaxton used Woolfenden's color-banding and demographic monitoring schemes to establish a parallel study of Florida Scrub-Jays in Sarasota County, where human population growth threatens the existence of the species in its largest remaining population along Florida's Gulf Coast (Thaxton and Hingten 1996). (Fortuitously for Florida Scrub-Jays, Thaxton later was elected county commissioner for Sarasota County, after running on a conservation platform.) Richard L. Zusi, retired from the U. S. National Museum of Natural History, observed and photographed scrub-jays opening peanuts and acorns during his study of the buttress complex that braces the partially opened jaw and enhances its use as a chisel in certain corvids (Zusi 1987).

Woolfenden's students.—Graduate students working with Woolfenden at USF helped draw world-wide attention to the scrub-jay project. Among the first was Anthony R. DeGange (M.S., 1976) who worked on annual and daily time budgets of the scrub-jays. This M.S. thesis has served as a valuable research resource for three decades.

DeGange made the historic discovery that each year, each Florida Scrub-Jay caches 6500 to 8000 acorns, ultimately recovering only about a third of them (DeGange et al. 1989). Jerre Ann Stallcup (M.S., 1976) found that the breeding male and older male helpers bring more food to nestlings than do yearling helpers or older female helpers. As the older males are the scrub-jays who most likely gain a territory by budding or direct inheritance, they may benefit the most from raising extra birds to defend and enlarge the territory (Stallcup and Woolfenden 1978). D. Bruce Barbour (M.S., 1977) cataloged the vocalizations of Florida Scrub-Jays, producing a thesis that continues to be the starting place for many behavioral analyses. G. Thomas Bancroft (M.S., 1982) compared molt of scrub-jays and Blue Jays in Florida, showing that Florida Scrub-Jays have a breed-then-molt pattern typical of temperate passerines, but that individual timing depends on sex, age, and status. Temperature and water regulation appear to be more important than nutritional or energy factors in determining the timing of molt (Bancroft and Woolfenden 1982). Bancroft, who obtained a Ph.D. from USF working on Boat-tailed Grackles (*Quiscalus major*), returned to the Station many years later to serve a stint directing agro-ecological research at MAERC (see above).

Kevin J. McGowan (Ph.D., 1987) studied the social development of young Florida Scrub-Jays. All members of the family group feed fledglings equally, and no brood division occurs (McGowan and Woolfenden 1990). Strong justification exists for considering the vigilance of scrub-jays to be part of a coordinated "sentinel" system: one scrub-jay quits watching as another takes over occurs more frequently than it would at random, and two scrub-jays on watch at the same time occurs much less frequently than expected in a random system (McGowan and Woolfenden 1989). Seasonal variation suggests that sentinel behavior serves primarily in predator detection. Sentinel contributions by helpers during the nesting season increased the total sentinel time of the group. This result contrasted with studies in winter showing that even with helpers standing sentinel, the group's total sentinel time either stayed the same or decreased (Hailman et al. 1994). This result parallels those of studies of other species, and suggests that with more ears and eyes, formal sentinel duty becomes less important. McGowan's work also contributed to understanding variation in the scrub-jay's lifetime fitness (McGowan and Woolfenden 1990, Fitzpatrick et al. 1988).

David C. Fleck (M.S., 1988) showed that Florida Scrub-Jays prefer acorns with high tannin (e.g., Chapman's oak, *Quercus chapmanii*) for caching and those with low tannin (e.g., sand live oak, *Q. geminata*) for immediate consumption. The oak species with high-tannin acorns offered a greater number of undamaged acorns for harvesting, and these acorns lasted longer when cached, suggesting that tannin inhibits damage from insect larvae (Fleck and Woolfenden 1997). Furthermore, by the time buried acorns are dug up for consumption, their tannin content has decreased, probably making them more palatable. Ron Schaub (M.S., 1990) showed that nest predation increased through the season, was heavier on nestlings than eggs, and was unrelated to frequency of nest visits by investigators. As nest predation occurred mainly in daylight hours, the major nest predators were deduced to be diurnal snakes (e.g., coachwhip, *Masticophis flagellum*) and a few species of birds (e.g., Blue Jay; Schaub et al. 1992).

Jill M. Goldstein (M.S., 1996) studied why Florida Scrub-Jay helpers that are step-offspring are statistically less likely to be found with a same-sex step-parent than with an opposite-sex step-parent. Balcombe (1989) had suggested that step-parents tolerate opposite-sex step-offspring because of the possibility of future pairing with them. Goldstein et al. (1998) offered the simpler interpretation that step-parents are more aggressive toward same-sex step-offspring because the latter are potential competitors. As a result of elevated aggression from step-parents, female helpers leave the natal territory sooner when with a step-mother than a genetic mother, and yearling male helpers leave sooner when with a step-father than a genetic father. Age-two helper males remain despite high aggression from the step-father, possibly because of their high probability of inheriting the natal territory or budding off part of it (Goldstein et al. 1998).

William J. Keating (M.S., 1999) studied nocturnal roosting by Florida Scrub-Jays. Leaving the nocturnal roost commences earliest on days when territorial defense is most frequent and latest when diurnal raptors are most abundant. These two peaks tend to occur during different times in the annual cycle. Especially because Brown-headed Cowbirds (*Molothrus ater*) have recently become breeders locally, Tina L. Fleischer (M.S., 2000) studied reactions by Florida Scrub-Jays to the addition of eggs and artificial eggs to their clutches. The scrub-jays ejected all shams, including those designed to look like scrub-jay eggs, and virtually all eggs from other species, but fewer than half of the

human-added real eggs of their own species (Fleischer and Woolfenden 2004). Kimberly B. Brand (M.S., 2001) showed that female Florida Scrub-Jays gained mass shortly before laying eggs, lost mass by the time the clutch was completed, and lost mass during incubation. Loss of mass by males coincided with feeding nestlings, suggesting that males undergo reproductive stress, whereas females experience depletion of energy reserves.

Fitzpatrick's students.—Brad Stith (Ph.D. 1999), advised by Fitzpatrick at the University of Florida, studied movements of radio-tagged Florida Scrub-Jays in non-scrub habitat (Stith 1999), conducted the first comprehensive metapopulation analysis of the Florida Scrub-Jay (Stith et al. 1996), and developed a detailed, individual-based spatially explicit landscape model for Florida Scrub-Jays (e.g., Breininger et al. 1999, Hokit et al. 2001). After moving to Cornell, Fitzpatrick directed Laura Stenzler (M.S., 2001), who studied the genetics of two bird species with very different dispersal strategies, using the scrub-jays as an example of a species that is extremely sedentary and demonstrating genetic isolation-by-distance within scrub-jays of the Lake Wales Ridge. Stenzler, who became lead molecular lab technician at the Cornell Lab of Ornithology, isolated the first large library of microsatellite loci for the Florida Scrub-Jays (Stenzler and Fitzpatrick 2002). Marita Davison (M.S. 2006) compared fitness of scrub-jays living in pasture lands with those living in their natural scrub habitat, and collaborated with Fitzpatrick in creating a county-wide habitat conservation plan for Florida Scrub-Jays in Sarasota County (Fitzpatrick et al. 2006).

Students of collaborators.—Jack Hailman's field observations of the scrub-jays began in 1979 (Hailman 1989, 1995; Hailman and Woolfenden 1985; Hailman et al. 1994). Hailman supervised four students at the University of Wisconsin who conducted research on the Florida Scrub-Jays at Archbold Biological Station. Ann Marie Francis (M.S., 1982) studied predator mobbing by performing field trials with a tethered, live snake released from a sack in the presence of the scrub-jays. She described the postures, movements, and vocalizations used in mobbing, and found that male breeders mobbed most intensely, fledglings least. Adults often ignored fledgling mobbing unless they saw the snake themselves (Francis et al. 1989). A. Margaret Elowson's (Ph.D., 1988) doctoral dissertation work investigated vocalizations elicited by

predators in wider contexts than mobbing. She found huge variation, which could be sorted into 12 types and subtypes based on multivariate analyses of acoustical variables. The meanings of different call types were unclear, but rise in frequency of the lowest component in calls appeared to correlate with the degree of danger, the extreme case being the overhead-predator alarm that causes scrub-jays to rush for cover (Elowson and Hailman 1991). Peter E. Midford (Ph.D., 1999) conducted doctoral research on social transmission of behavior, by teaching scrub-jays a new foraging situation and tracking spread of the behavior. Midford demonstrated that naive scrub-jays could learn from interacting with scrub-jays previously trained to find food in a novel foraging patch (Midford et al. 2000). Douglas A. Kramer (M.S., 2000) showed by tracking individually marked cached acorns that scrub-jays in the wild retrieve their own caches.

Ronald L. Mumme began coming to the Station with assistants and students in 1986 and his initial research involved testing the effects of helpers via controlled experiments. Groups with their helpers removed suffered higher predation on nestlings and lower fledgling survival, producing on average only one third the number of independent juveniles as did the control groups (Mumme 1991, 1992). A two-lane paved county highway runs through part of Archbold Biological Station (see Figure 3), and Mumme found that annual mortality of breeders with territories touching or spanning the highway was higher than that of breeders on interior territories (Mumme et al. 2000). Mumme's student at Allegheny College, Jennifer Barg, wrote a Senior Honor's thesis (1992) in which she found through playback experiments that breeders react slightly more positively to begging calls of their own fledglings than to fledglings of other breeders (Barg 1992, Barg and Mumme 1994). Kris J. McFadden (1992) also wrote a Senior's Honors thesis involving time budgets and breeding.

Robert L. Curry, a professor at Villanova University, joined the Florida Scrub-Jay project as a post-doctoral associate in 1987, initially funded by an NSF grant to Fitzpatrick and Woolfenden to establish long-term monitoring of ecological resources and foraging behavior. Curry has advised several M.S. students conducting research on the scrub-jays. Lee M. Walton (M.S., 1997) studied nest-site selection in two different habitats, Elizabeth M. Borst (M.S., 1998) examined factors affecting laying date and clutch size, and Chris Valligny (M.S.,

2003) compared foraging by Florida Scrub-Jays in recently burned scrub and those foraging in long unburned scrub.

Thomas C. Grubb, Jr., of Ohio State University, had three students earn graduate degrees for field work at the Station. Jonathan A. Smallwood (Ph.D., 1987a) worked on sex and habitat choice of wintering American Kestrels. As mentioned elsewhere, Reuven Yosef (Ph.D., 1992a) studied Loggerhead Shrikes at MAERC. Grubb applied his technique of assessing nutritional condition by measuring the width of growth bars in feathers to the Florida Scrub-Jay system (Grubb et al. 1998). This "ptilochronology" technique was used by his M.S. student, Kathleen K. Harris (M.S., 1993), to examine nutritional condition and survivorship of scrub-jay fledglings.

Reed Bowman has directed several students and interns on Florida Scrub-Jay projects in the suburban study site north of the Station. Arthur L. Fleischer, Jr. (M.S., 2000) compared time budgets of female breeders in the suburbs with those in the natural scrub at the Station to investigate the causes of different breeding times in the two populations. Sonya C. LeClair (M.S., 2005) studied hatching failure in the two populations; Annette Sauter (Ph.D., 2005) studied effects of human-provided foods on nestling growth and survival. Matthew D. Shawkey (M.S., 2001) compared proximate causes of brood reduction in the two populations.

Other coauthors.—Diversification of research on the Florida Scrub-Jay at Archbold Biological Station was greatly enhanced by collaborating investigators. Ian Rowley, Stephen T. Emlen, and A. J. Gaston, all of whom have visited the Station to observe the scrub-jay project, with Woolfenden, published a short paper that defined a group in social birds (Rowley et al. 1979). Bertram G. Murray published with Fitzpatrick and Woolfenden on the evolution of clutch size (Murray et al. 1989). Mark T. Kopeny joined Fitzpatrick and Woolfenden on a report concerning habitat requirements for the scrub-jays (Fitzpatrick et al. 1991). John M. Marzluff and Russell P. Balda collaborated with Woolfenden and Fitzpatrick in comparing "breeding partnerships" in jay species (Marzluff et al. 1996). Brad M. Stith (Ph.D., University of Florida, 1999) and Bill Pranty joined Fitzpatrick and Woolfenden on using the Florida Scrub-Jay as a case study in classifying metapopulations (Stith et al. 1996). James S. Quinn, along with Fitzpatrick,

Woolfenden, and Bradley N. White, reported on genetic monogamy in the species (Quinn et al. 1999). D. B. McDonald and W. K. Potts collaborated with Fitzpatrick and Woolfenden on genetics of scrub-jays (McDonald et al. 1996, 1999). McDonald, Fitzpatrick and Woolfenden (McDonald et al. 1996) also published on senescence and demographic heterogeneity in Florida Scrub-Jays. To round out coauthorships in the 1990s, Joanna Burger and Michael Gochfeld collaborated with Woolfenden and Bowman on studies of metal concentrations in eggs of the scrub-jays (Burger et al. 1999, 2004). More recently, two demographers, Gordon A. Fox from USF, and Bruce E. Kendall, University of California, Santa Barbara, worked with Fitzpatrick and Woolfenden on the scrub-jay data. Survival probabilities are structured by age, birth cohort, and maternal family, but not by sex. Structural heterogeneity exists in the population, which reduces demographic stochasticity (Fox et al. 2006).

Interns and volunteers.—In addition to the students working at Archbold Biological Station on the scrub-jays for graduate degrees, many interns and volunteers worked on the scrub-jay project. These included: Robert Aldredge, Anna-Laura Averill, Tyler Beck, Miles Becker, Barbara Beckford-Nemes, Aina Bernier, Craig Carter, Vickie Cleveland, Ondi Crino, Michelle Dent, Courtney Fitzpatrick, Catherine Graham, Brian Harrington, Arnon HersHKovitz, Erin Hewett, Jo-Ann Jennier, Rebecca Kimball, Lisa Klein, Ipek Kulahci, Joanna Leary, Ari Levine, Daniel Levitis, Kevin Lyon, Walter Meshaka, David Moore, Erin Muths, Brian Nelson, Martha Noble, Kelvin Peh, Jill Richardson, Ralph Schreiber, Brent Sewall, Amy Shipley, Kat Smith, Rua Stob, Nancy Stotz, Carole Sumner, Katherine Thorington, Matthew Toomey, Ximena Valderrama, James Wagner, Martin Weggler, and James Weinrich.

GRADUATE STUDENTS STUDYING BIRDS OTHER THAN SCRUB-JAYS

Numerous students have studied other species of birds at Archbold Biological Station. The following list excludes a few already mentioned above. Keith A. Tarvin (Ph.D., University of South Florida, 1998) studied the influence of habitat variation, dominance, and aggression on

Blue Jay populations (Tarvin and Woolfenden 1997). He and Woolfenden also wrote the Blue Jay account for the *Birds of North America* series (Tarvin and Woolfenden 2000). Mary C. Garvin (Ph.D., University of Florida, 1996) studied blood parasites of Blue Jays and Florida Scrub-Jays (Garvin et al. 2004). Sylvia L. Halkin (M.S., University of Wisconsin, 1983) studied winter habitat of the Northern Mockingbird (*Mimus polyglottos*). While a graduate student at the University of Arizona, Mary C. McKittrick (1979) studied territory size of Bachman's Sparrow (*Aimophila aestivalis*). Brian S. Nelson (M.S., Florida International University, 1998) studied bioacoustic aspects of Eastern Towhee vocalizations. At the agro-ecology ranch, Christine Champe (M.S., University of Florida, 1993) compared bird communities in native and agricultural habitats.

SPEAKERS, CLASSES, MEETINGS, AND CONFERENCES

A formal program of invited outside speakers at Archbold Biological Station evolved gradually out of informal talks given by visiting investigators who were conducting research at the Station. The program was facilitated by completion in 1987 of the Annex with its excellent lecture room. Seminars have featured familiar names in North American ornithology, as well as speakers from other countries (e.g., Australia, Belgium, Cuba, Germany, Great Britain, Israel, Mexico, New Zealand, South Africa).

Each year, college and university classes from around the eastern United States visit Archbold Station to study field ecology and vertebrate biology, including ornithology. In addition to many of Florida's schools, classes from Cornell, Harvard, University of Chicago, Auburn, and Wake Forest University are especially frequent. The Station is an excellent venue for modestly sized special conferences, annual meetings of societies and organizations, and small working groups or committees. Ornithological meetings of note have included: Dusky Seaside Sparrow Recovery Team (1977); Executive Committee, Florida Ornithological Society (1983, 1992, 1993); Florida Breeding Bird Atlas working group (1987); International Shrike Symposium (1993, consisting of 71 attendees from many countries); Florida Ornithological Society (1993, with 120 attendees, one of the largest meetings ever hosted by the Station); Florida Ornithological Society Records

Committee (1993, and annually thereafter); American Ornithologists' Union Committee on Classification and Nomenclature (1994); Southwest Florida Regional Workshop for Red-cockaded Woodpecker Ecosystem Management (1994); Florida Fish and Wildlife Conservation Commission's SE Wild Turkey Committee (1994); Florida Audubon Society Board of Directors (1995 and 1996); Cornell



Figure 12. The Florida Scrub-Jay Habitat Conservation Plan group as assembled on 13 December 1993 at Archbold Biological Station (ABS). The group included Station ornithologists, a genetics group from University of Florida (UF), the Statewide census team, academic and agency biologists from Merritt island/Brevard County area, and an independent researcher of the dwindling Gulf Coast population. Standing, L-R: Glen Woolfenden (ABS), Scott Edwards (UF), Douglas Stotz (ABS), Karen Achey (UF), Jon Thaxton (Sarasota, Florida), Hilary M. Swain (Florida Institute of Technology, currently Archbold Biological Station's executive director, 1995-), Brian Toland (Florida Conservation Commission), Wayne Potts (UF), Brad Stith (ABS), David Breinger (Bionetics Corporation), Reed Bowman (ABS), Jack Dozier (Alligator Point, Florida); Kneeling, L-R: David McDonald and Wendy Flanagan (UF), Bill Pranty, and John Fitzpatrick (ABS). Photograph by Nancy D. Deyrup.

Laboratory of Ornithology Administrative Board (1997); North American Banding Council (1999). Since 1991, numerous working groups (including the U.S. Fish and Wildlife's Florida Scrub-Jay Recovery Team; Figure 12) have met at the Station to discuss conservation strategies and action plans for recovery of the endangered Florida Scrub-Jay.

Since 1987, Archbold Biological Station has jointly sponsored the Lake Placid Christmas Bird Count with the Highlands County Audubon Society, during which the Station houses various out-of-town expert participants. In some years, this count has had the highest species total for any non-coastal count east of Texas, and in all years the count includes highest continental totals for several species. A "count-down" with refreshments is hosted by the Station at the end of the count day.

CONCLUDING REMARKS

Ornithology at Archbold Biological Station continues to be dominated by the Florida Scrub-Jay project. This is a long-term field study of a single taxon, which began at one locality, and has grown to cover the entire range of the species. The objectives are to learn everything about this species' behavior and ecology. This integrated approach emphasizes careful accumulation of data in the field, capitalizing on deep fascination with nature on the part of the professionals and students involved. Great field stations attract this type of scientist.

At Archbold Biological Station, staff biologists are expected to conduct most of their field research on the Station's property, or at other representative examples of central Florida's ecosystems. As the Station's field biologists follow their own fascinations with nature, their various research interests often overlap and intersect so that each separate project is enriched by the others' knowledge about the site. Questions about a bird's prey relationships, habitat use, responses to abiotic factors, or recovery from environmental extremes (drought, flood, fire, hurricane) are all elucidated by shared experience, or puzzlement, of investigators in the Station's entomology, plant ecology, and vertebrate ecology labs. This shared experience is a significant benefit of conducting research at Archbold Biological Station. We hope that this history of ornithology at Archbold Biological Station provides inspira-

tion for those seeking to sustain a long-term study throughout, and beyond, a research career.

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LITERATURE CITED (*) AND BIBLIOGRAPHY (publications, theses, and dissertations pertaining to bird research at Archbold Biological Station and publications by Archbold staff pertaining to Florida birds, 1942-2006)

- *Abrahamson, W. G., A. F. Johnson, J. N. Layne, and P. A. Peroni. 1984. Vegetation of the Archbold Biological Station, Florida: an example of the southern Lake Wales Ridge. *Florida Scientist* 47:209-250.
- *Amadon, D. 1944a. Results of the Archbold Expeditions. No. 50. A preliminary life history study of the Florida Jay, *Cyanocitta c. coerulescens*. *American Museum Novitates* 1252:1-22.
- *Amadon, D. 1944b. Comparative weights of northern and southern subspecies. *Auk* 61:136-137.
- *Amadon, D. 1956. Results of the Archbold Expeditions. No. 73. Birds of the Archbold Biological Station, Lake Placid, Florida. *American Museum Novitates* 1790:1-22.
- *Anonymous. 1986. William Brewster Memorial Award, 1985: Glen E. Woolfenden and John W. Fitzpatrick. *Auk* 103:450.
- *Archbold, R. 1967. Archbold Expeditions / Archbold Biological Station,

- Annual Report of Activities, May 1, 1966 through April 30, 1967. Archbold Biological Station, Lake Placid, Florida.
- *Archbold, R., and J. L. Layne. 1968. Annual Report: 1967-68, Archbold Biological Station, Lake Placid, Florida.
- *Archbold, R., and A. L. Rand. 1940. New Guinea expedition: Fly River area 1936-1937. Robert M. McBride and Co., New York.
- Bailey, E. E., G. E. Woolfenden, and W. B. Robertson, Jr. 1987. Abrasion and loss of bands from Dry Tortugas Sooty Terns. *Journal of Field Ornithology* 58:413-424.
- *Balcombe, J. P. 1989. Non-breeder asymmetry in Florida Scrub Jays. *Evolutionary Ecology* 3:77-79.
- *Bancroft, G. T. 1982. The molt of Scrub Jays and Blue Jays in Florida. M.A. thesis, University of South Florida, Tampa.
- Bancroft, G. T. 1996. White-crowned Pigeon (*Columba leucocephala*). Pp. 256-266 in J. A. Rodgers, Jr., H. W. Kale II, and H. T. Smith, eds., *Rare and Endangered Biota of Florida*. Vol. V. Birds. University Press of Florida, Gainesville.
- Bancroft, G. T., and R. Bowman. 1994. Crop milk and fruit in the diet of nestling White-crowned Pigeons. *Auk* 111:844-852.
- Bancroft, G. T., R. Bowman, and R. Sawicki. 2000. Rainfall, fruiting phenology and the nesting season of White-crowned Pigeons in the Upper Florida Keys. *Auk* 117:416-426.
- Bancroft, G. T., and A. M. Strong. 1996. Yellow-crowned Night-Heron (*Nyctanassa violacea*). Pp. 450-456 in J. A. Rodgers, Jr., H. W. Kale II, and H. T. Smith, eds., *Rare and Endangered Biota of Florida*. Vol. V. Birds. University Press of Florida, Gainesville.
- *Bancroft, G. T., and G. E. Woolfenden. 1982. The molt of Scrub Jays and Blue Jays in Florida. *Ornithological Monographs* 29:1-51.
- *Barbour, D. B. 1977. Vocal communication in the Florida Scrub Jay. M.S. thesis, University of South Florida, Tampa.
- *Barg, J. J. 1992. Parental recognition of juvenile begging calls in the Florida Scrub Jay, *Aphelocoma coerulescens*. Senior Honors thesis, Allegheny College, Meadville, Pennsylvania.
- *Barg, J. J., and R. L. Mumme. 1994. Parental recognition of juvenile begging calls in the Florida Scrub Jay. *Auk* 111:459-464.
- *Bednekoff, P. A., and G. E. Woolfenden. 2003. Florida Scrub-Jays (*Aphelocoma coerulescens*) are sentinels more when well-fed (even with no kin nearby). *Ethology* 109:895-903.
- *Bednekoff, P. A., and G. E. Woolfenden. 2006. Florida Scrub-Jays compensate for the sentinel behavior of flockmates. *Ethology* 112:796-800.
- Belt, W. D., M. N. Sheridan, R. A. Knouff, and F. A. Hartman. 1965. Fine structural study of a possible mechanism of secretion by the interrenal cells of the Brown Pelican. *Zeitschrift für Zellforschung* 68:864-873.
- *Borst, E. M. 1998. Effects of breeder age, breeder experience, and pair-bond duration on clutch initiation date and clutch size in Florida Scrub-Jays. M.S. thesis, Villanova University, Villanova, Pennsylvania.
- *Bowman, R. 1992. Asynchronous hatching and brood reduction in the White-crowned Pigeon (*Columba leucocephala*). Ph.D. dissertation, University of South Florida, Tampa.
- Bowman, R. 1994. Frugivory, gut morphology and reproductive constraints in

- New World *Columba* pigeons. *Journal für Ornithologie* 135:292-293.
- Bowman, R. 1996. Key West Quail-Dove (*Geotrygon chrysia*). Pp. 17-23 in J. A. Rodgers, Jr., H. W. Kale II, and H. T. Smith, eds., *Rare and Endangered Biota of Florida*. Vol. V. Birds. University Press of Florida, Gainesville.
- Bowman, R. 1996. Zenaida Dove (*Zenaida aurita*). Pp. 24-30 in J. A. Rodgers, Jr., H. W. Kale II, and H. T. Smith, eds., *Rare and Endangered Biota of Florida*. Vol. V. Birds. University Press of Florida, Gainesville.
- Bowman, R. 2002. Common Ground-Dove (*Columbina passerina*). Pp. 1-24 in A. Poole and F. Gill, eds., *The Birds of North America*, no. 645. American Ornithologists' Union, Washington D.C., and Cornell Laboratory of Ornithology, Ithaca, New York.
- *Bowman, R. 2003. Apparent cooperative hunting in the Florida Scrub-Jay. *Wilson Bulletin* 115:197-199.
- Bowman, R. 2004. Fourteenth report of the Florida Ornithological Society Records Committee: 2001-2002. *Florida Field Naturalist* 32:7-33.
- Bowman, R., and D. A. Aborn. 2001. Effects of different radio transmitter harnesses on the behavior of Florida Scrub-Jays. *Florida Field Naturalist* 29:165-169.
- Bowman, R., and C. Huh. 1995. Tree characteristics, resin flow, and heartwood rot in pines (*Pinus elliottii*, *P. palustris*) with respect to Red-cockaded Woodpecker cavity excavation, in two hydrologically-distinct Florida flat-wood communities. Pp. 415-426 in D. L. Kulhavy, R. G. Cooper, and R. Costa, eds., *Red-cockaded Woodpecker: Recovery, Ecology and Management*. Center for Applied Studies in Forestry, Nacogdoches, Texas.
- Bowman, R., D. L. Leonard, L. K. Backus, and A. R. Mains. 1999. Interspecific interactions with foraging Red-cockaded Woodpeckers in south-central Florida. *Wilson Bulletin* 111:346-353.
- Bowman, R., D. L. Leonard, Jr., D. Swan, and D. Schwalm. 2004. Demography and population trends of a small Red-cockaded Woodpecker population in south-central Florida. Pp. 187-197 in R. Costa and S. J. Daniels, eds. *Red-cockaded Woodpecker: Road to Recovery*. Hancock House Publishers, Blaine, Washington.
- Bowman, R., and J. M. Marzluff. 2001. Integrating avian ecology into emerging paradigms in urban ecology. Pp. 569-578 in J. M. Marzluff, R. Bowman, and R. Donnelly, eds., *Avian Conservation and Ecology in an Urbanizing World*. Kluwer Academic Publishers, Boston.
- Bowman, R., P. W. Smith, and J. W. Fitzpatrick. 1995. First winter record of an Eastern Kingbird in Florida. *Florida Field Naturalist* 23:62-64.
- Bowman, R., and G. E. Woolfenden. 1992. Current Scrub Jay research at Archbold Biological Station. *Florida Naturalist* 65:13, 22.
- Bowman, R., and G. E. Woolfenden. 1997. Nesting chronology of the Common Ground-Dove in Florida and Texas. *Journal of Field Ornithology* 68:580-589.
- Bowman, R., and G. E. Woolfenden. 1998. The scrub and the scrub-jay: imperiled natural treasures of Florida. *Florida Naturalist* 71:10-11.
- *Bowman, R., and G. E. Woolfenden. 2001. Nest success and the timing of nest failure of Florida Scrub-Jays in suburban and wildland habitats. Pp. 383-402 in J. M. Marzluff, R. Bowman, and R. Donnelly, eds., *Avian Conservation and Ecology in an Urbanizing World*. Kluwer Academic Publishers, Boston.

- *Bowman, R., and G. E. Woolfenden. 2002. Nest-sites of Florida Scrub-Jays in natural and human modified habitats. *Wilson Bulletin* 114:128-135.
- *Brand, K. B. 2001. Body mass variation in breeding Florida Scrub-Jays (*Aphelocoma coerulescens*). M.S. thesis, University of South Florida, Tampa.
- *Brass, L. J. 1944. The Archbold Biological Station. *Science* 100:594-595.
- *Breininger, D. R., M. A. Burgman, and B. M. Stith. 1999. Influence of habitat quality, catastrophes, and population size on extinction risk of the Florida Scrub-Jay. *Wildlife Society Bulletin* 27:810-822.
- Breitwisch, R. J. 1977. The ecology and behavior of the Red-bellied Woodpecker, *Centurus carolinus* (Linnaeus) (Aves: Picidae) in south Florida. M.S. thesis, University of Miami, Miami, Florida.
- Brower, L. P., J. V. Z. Brower, and J. M. Corvino. 1967. Plant poisons in a terrestrial food chain. *Proceedings of the National Academy of Sciences* 57:893-898.
- *Brower, L. P., W. N. Ryerson, L. L. Coppinger, and S. C. Glazier. 1968. Ecological chemistry and the palatability spectrum. *Science* 161:1349-1351.
- *Brown, J. L. 1978. Avian heirs of territory. *BioScience* 28:750-752.
- *Burger, J., R. Bowman, G. E. Woolfenden, and M. Gochfeld. 2004. Metal and metalloid concentrations in the eggs of threatened Florida Scrub-Jays in suburban habitat from south-central Florida. *Science of the Total Environment* 328:185-193.
- *Burger, J., G. E. Woolfenden, and M. Gochfeld. 1999. Metal concentrations in the eggs of endangered Florida Scrub-Jays from central Florida. *Archives of Environmental Contamination and Toxicology* 37:385-388.
- Carrell, J. E. 1984. Tree Swallow flock preys on swarming termites. *Florida Field Naturalist* 12:12-13.
- Carter, T. D., and F. A. Hartman. 1947. Birds wintering in the Fakahatchee Swamp region, Florida. *Florida Naturalist* 20:49-52.
- *Champe, C. 1993. Bird communities in native and agricultural habitats in south-central Florida. M.S. thesis, University of Florida, Gainesville.
- *Cink, C. L., and F. E. Lohrer. 1990a. Recently burned scrubby flatwoods [winter bird population study]. *Journal of Field Ornithology* 61(supplement):17.
- *Cink, C. L., and F. E. Lohrer. 1990b. Sand pine scrub [winter bird population study]. *Journal of Field Ornithology* 61(supplement):13.
- *Collins, C. T., and K. A. Corey. 2005. Territory acquisition by Island Scrub-Jays: how to become a breeder. Pp. 257-262 in D. K. Garcelon and C. A. Schwemm, eds., *Proceedings of the Sixth Channel Islands Symposium*. National Park Service Technical Publication CHIS-05-01. Institute for Wildlife Studies, Arcata, California.
- Coppinger, R. P. 1970. The effect of experience and novelty in avian feeding behavior with reference to the evolution of warning coloration in butterflies. II. Reaction of naive birds to novel insects. *American Naturalist* 104:323-335.
- *Coulon, A., J. W. Fitzpatrick, R. Bowman, B. M. Stith, C. A. Makarewich, L. M. Stenzler, and I. J. Lovette. 2008. Congruent population structure inferred from dispersal behaviour and intensive genetic surveys of the threatened Florida Scrub-jay (*Aphelocoma coerulescens*). *Molecular*

Ecology 17:1685-1701.

- *Cox, J. A. 1984. Distribution, habitat, and social organization of the Florida Scrub Jay, with a discussion of the evolution of cooperative breeding in New World jays. Ph.D. dissertation, University of Florida, Gainesville.
- *Cox, J. A. 1987. Status and distribution of the Florida Scrub Jay. Florida Ornithological Society Special Publication no. 3.
- Curry, R. L. 1990. Florida Scrub Jay kills a mockingbird. *Condor* 92:256-257.
- *Davison, M. A. 2006. Life in an altered landscape: reproductive success and foraging efficiency of Florida Scrub-Jays (*Aphelocoma coerulescens*) in regenerating pasture. M.S. thesis, Cornell University, Ithaca, New York.
- *DeGange, A. R. 1976. The daily and annual time budget of the Florida Scrub Jay. M.S. thesis University of South Florida, Tampa.
- *DeGange, A. R., J. W. Fitzpatrick, J. N. Layne, and G. E. Woolfenden. 1989. Acorn harvesting by Florida Scrub Jays. *Ecology* 70:348-356.
- Denton, J. F., and W. A. Krissinger. 1975. *Lyperosomum byrdi* sp. n. (Digenea: Dicrocoeliidae) from the Rufous-sided Towhee, *Pipilo erythrophthalmus* (L.), with a revised synopsis of the genus. *Proceedings of the Helminthological Society of Washington* 42:38-42.
- Douglass, J. F. 1977. Prairie Warbler feeds from spider web. *Wilson Bulletin* 89:158-159.
- *Dugger, B. D., S. L. Melvin, and R. S. Finger. 2005. Abundance and community composition of waterbirds using the channelized Kissimmee River floodplain, FL. *Southeastern Naturalist* 4:435-446.
- *Elowson, A. M. 1988. Analysis of complex acoustical variation: predator-elicited calls of the Florida Scrub Jay. Ph.D. dissertation, University of Wisconsin, Madison.
- *Elowson, A. M., and J. P. Hailman. 1991. Analysis of complex variation: dichotomous sorting of predator-elicited calls of the Florida Scrub Jay. *Bioacoustics* 3:295-320.
- Emlen, J. T. 1973. Vocal stimulation in the Great Horned Owl. *Condor* 75:126-127.
- *Emlen, J. T. 1978. Density anomalies and regulatory mechanisms in land bird populations on the Florida peninsula. *American Naturalist* 112:265-286.
- *Emlen, J. T. 1980. Interactions of migrant and resident land birds in Florida and Bahama pinelands. Pp. 133-143 in A. Keast and E. S. Morton, eds., *Migrant Birds in the Neotropics: Ecology, Behavior, Distribution, and Conservation*. Smithsonian Institution Press, Washington, D.C.
- *[Fitzpatrick, J. W. 1991]. Archbold Biological Station of Archbold Expeditions, 49th Annual Report, 1990. Archbold Biological Station, Lake Placid, Florida.
- *Fitzpatrick, J. W., M. A. Davison, and B. Stith. 2006. Habitat conservation plan for the Threatened Florida Scrub-Jay (*Aphelocoma coerulescens*) in Sarasota County, Florida. Final Report, on file at Sarasota County Natural Resources Unit, Sarasota County, Florida.
- Fitzpatrick, J. W., and G. E. Woolfenden. 1978. Red-tailed Hawk preys on juvenile gopher tortoise. *Florida Field Naturalist* 6:49.
- *Fitzpatrick, J. W., and G. E. Woolfenden. 1981. Demography is a cornerstone of sociobiology. *Auk* 98:406-407.
- *Fitzpatrick, J. W., and G. E. Woolfenden. 1983. Staying around the nest. Pp. 13-25 in A. R. Hamlet, ed., *Science Year The World Book Science Annual*.

World Book Inc., Chicago, Illinois.

- *Fitzpatrick, J. W., and G. E. Woolfenden. 1984. The helpful shall inherit the scrub. *Natural History* 93:55-63.
- *Fitzpatrick, J. W., and G. E. Woolfenden. 1986. Demographic routes to cooperative breeding in some New World jays. Pp. 137-160 in M. Nitecki and J. Kitchell, eds., *Evolution of Behavior*. University of Chicago Press, Chicago, Illinois.
- *Fitzpatrick, J. W., and G. E. Woolfenden. 1988. Components of lifetime reproductive success in the Florida Scrub Jay. Pp. 305-320 in T. Clutton-Brock, ed., *Reproductive Success*. University of Chicago Press, Chicago, Illinois.
- *Fitzpatrick, J. W., and G. E. Woolfenden. 1989. Florida Scrub Jay. Pp. 201-218 in I. Newton, ed., *Lifetime Reproduction in Birds*. Academic Press, London.
- *Fitzpatrick, J. W., and G. E. Woolfenden. 1996. Florida Scrub-Jay forages on back of white-tailed deer. *Condor* 98:422-423.
- *Fitzpatrick, J. W., G. E. Woolfenden, and R. Bowman. 1999. Dispersal distance and its demographic consequences in the Florida Scrub-Jay. Pp. 2465-2479 in N. J. Adams and R. H. Slotow, eds., *Proceedings 22nd International Ornithological Congress*, Durban, South Africa, 16-22 August 1988. Birdlife South Africa.
- *Fitzpatrick, J. W., G. E. Woolfenden, and M. T. Kopeny. 1991. Ecology and development-related habitat requirements of the Florida Scrub Jay (*Aphelocoma coerulescens coerulescens*). Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program Technical Report no. 8.
- *Fitzpatrick, J. W., G. E. Woolfenden, and K. J. McGowan. 1988. Sources of variance in lifetime fitness of Florida Scrub Jays. Pp. 876-891 in H. Ouellet, ed., *Acta XIX Congressus Internationalis Ornithologici*. National Museum of Natural Sciences, Ottawa, Canada.
- *Fleck, D. C. 1988. Acorn tannin influences on the caching behavior of the Florida Scrub Jay (*Aphelocoma c. coerulescens*). M.S. thesis, University of South Florida, Tampa.
- *Fleck, D. C., and G. E. Woolfenden. 1997. Can acorn tannin predict scrub-jay caching behavior? *Journal of Chemical Biology* 23:793-806.
- *Fleischer, Jr., A. L. 2000. The influence of time budget and rate of food handling and consumption on the timing of breeding of female Florida Scrub-Jays (*Aphelocoma coerulescens*): a comparison between populations in natural and suburban habitats. M.S. thesis, University of South Florida, Tampa.
- *Fleischer, Jr., A. L., R. Bowman, and G. E. Woolfenden. 2003. Variation in foraging behavior, diet, and time of breeding of Florida Scrub-Jays in suburban and wildland habitats. *Condor* 105:515-527.
- *Fleischer, T. L. 2000. Reactions of Florida Scrub-Jays (*Aphelocoma coerulescens*) to eggs and shams added to their nests. M.S. thesis, University of South Florida, Tampa.
- *Fleischer, T., and G. E. Woolfenden. 2004. Florida Scrub-Jays eject foreign eggs added to their nests. *Journal of Field Ornithology* 75:49-50.
- Foster, G. W., J. L. Morrison, C. S. Hartless, and D. L. Forrester. 1998. *Haemoprotheus tinnunculi* in Crested Caracaras (*Caracara plancus audubonii*) from south-central Florida. *Journal of Raptor Research* 32:159-162.

- *Fox, G. A., B. E. Kendall, J. W. Fitzpatrick, and G. E. Woolfenden. 2006. Consequences of heterogeneity in survival probability in a population of Florida Scrub-Jays. *Journal of Animal Ecology* 75:921-927.
- *Francis, A. M. 1982. Mobbing behavior of Florida Scrub Jays: division of labor and ontogeny. M.S. thesis, University of Wisconsin, Madison.
- *Francis, A. M., J. P. Hailman, and G. E. Woolfenden. 1989. Mobbing by Florida Scrub Jays: behaviour, sexual asymmetry, role of helpers and ontogeny. *Animal Behaviour* 38:795-816.
- *Garvin, M. C. 1996. *Haemoproteus danilewski* Kruse, 1890, in Blue Jays in south-central Florida: epizootiology, pathogenicity and effect on host reproductive success. Ph.D. dissertation, University of Florida, Gainesville.
- *Garvin, M. C., K. A. Tarvin, L. M. Stark, G. E. Woolfenden, J. W. Fitzpatrick, and J. F. Day. 2004. Arboviral infection in two species of wild jays (Aves: Corvidae): evidence for population impacts. *Journal of Medical Entomology* 41:215-225.
- *Goldstein, J. M. 1996. The influence of stepparents on helper duration at home in the Florida Scrub-Jay (*Aphelocoma coerulescens*). M.S. thesis, University of South Florida, Tampa.
- *Goldstein, J. M., G. E. Woolfenden, and J. P. Hailman. 1998. A same-sex step-parent shortens a prebreeder's duration on the natal territory: tests of two hypotheses. *Behavioral Ecology and Sociobiology* 44:15-22.
- Goldstein, R. B. 1978. Geographic variation in the "ho-y" call of the Bobwhite. *Auk* 95:85-94.
- *Grimes, S. A. 1940. Scrub Jay reminiscences. *Bird Lore* 42:431-436.
- *Grubb, T. C., Jr., G. E. Woolfenden, and J. W. Fitzpatrick. 1998. Factors affecting nutritional condition of fledgling Florida Scrub-Jays: a ptilochronology approach. *Condor* 100:753-756.
- Grubb, T. C., Jr., and R. Yosef. 1994. Habitat-specific nutritional condition in Loggerhead Shrikes (*Lanius ludovicianus*): evidence from ptilochronology. *Auk* 111:756-759.
- Haig, S. M., R. Bowman, and T. J. Mullins. 1996. Population structure of Red-cockaded Woodpeckers in south Florida: RAPDs revisited. *Molecular Ecology* 5:725-734.
- *Hailman, J. P. 1989. Common Ground-Dove's injury feigning distracts Florida Scrub Jay. *Auk* 106:742.
- Hailman, J. P. 1990. Blue Jay mimics Osprey. *Florida Field Naturalist* 18:81-82.
- *Hailman, J. P. 1995. Toward operationality of a species concept. Pp. 103-122 in D. H. Lambert and H. G. Spencer, eds., *Speciation and the Recognition Concept: Theory and Application*. Johns Hopkins University Press, Baltimore, Maryland.
- *Hailman, J. P., and J. T. Emlen. 1985. A fawn colored Black Vulture in Glades County, Florida. *Florida Field Naturalist* 13:20.
- *Hailman, J. P., K. J. McGowan, and G. E. Woolfenden. 1994. Role of helpers in the sentinel behaviour of the Florida Scrub Jay (*Aphelocoma c. coerulescens*). *Ethology* 97:119-140.
- *Hailman, J. P., and G. E. Woolfenden. 1985. Nest defense of the Florida Scrub Jay and the problem of "incubation" by male passerines. *Wilson Bulletin* 97:370-372.
- *Halkin, S. L. 1983. Mockingbird occupancy of a wintering area little used for

- breeding. M.S. thesis, University of Wisconsin, Madison.
- Harrington, B. A., R. W. Schreiber, and G. E. Woolfenden. 1972. The distribution of male and female Magnificent Frigatebirds, *Fregata magnificens*, along the Gulf coast of Florida. *American Birds* 26:927-931.
- *Harris, K. K. 1993. Nutritional condition and survivorship in fledgling Florida Scrub Jays: a ptilochronology approach. M.S. thesis, Ohio State University, Columbus.
- Hartman, F. A. 1955. Heart weight in birds. *Condor* 57:221-238.
- *Hartman, F. A. 1961. Locomotor mechanisms of birds. *Smithsonian Miscellaneous Collections* 143:1-91.
- Hartman, F. A., and R. H. Albertin. 1951. A preliminary study of the avian adrenal. *Auk* 68:202-209.
- Hartman, F. A., R. A. Knouff, A. W. McNutt, and J. E. Carver. 1947. Chromaffin patterns in bird adrenals. *Anatomical Record* 97:211-222.
- Hartman, F. A., and M. A. Lessler. 1963. Erythrocyte measurements in birds. *Auk* 80:467-473.
- Henderson, J. R., N. Karabatsos, A. T. C. Bourke, R. C. Wallis, and R. M. Taylor. 1962. A survey for arthropod-borne viruses in southcentral Florida. *American Journal of Tropical Medicine and Hygiene* 11:800-810.
- Hoffman, W., and G. E. Woolfenden. 1986. A fledgling Brown-headed Cowbird specimen from Pinellas County. *Florida Field Naturalist* 14:18-20.
- Hoffman, W., and G. E. Woolfenden. 1988. A specimen of the Asiatic Marbled Murrelet from Florida. *Florida Field Naturalist* 16:37-38.
- *Hoffman, W., G. E. Woolfenden, and P. W. Smith. 1999. Antillean Short-eared Owls invade south Florida. *Wilson Bulletin* 111:303-313.
- *Hokit, D. G., B. M. Stith, and L. C. Branch. 2001. Comparison of two types of metapopulation models in real and artificial landscapes. *Conservation Biology* 15:1102-1113.
- Hopkins, L., and G. E. Woolfenden. 1977. Fourth record of the Arctic Loon from Florida. *Florida Field Naturalist* 5:12.
- Huizinga, H. W. 1966. Studies on the life cycle and development of *Contracaecum spiculigerum* (Rudolph, 1809) (Ascaroidea: Heterocheilidae) from marine piscivorous birds. *Journal of the Elisha Mitchell Scientific Society* 82:181-195.
- Johnston, R. F. 1961. The genera of American Ground Doves. *Auk* 78:372-378.
- Johnston, R. F. 1962. Precocious sexual competence in the Ground Dove. *Auk* 79:269-270.
- *Johnston, R. F. 1964. Remarks on the behavior of the Ground Dove. *Condor* 66:65-69.
- *Keating, W. J. 1999. Nocturnal roosting behavior of the Florida Scrub-Jay. M.S. thesis, University of South Florida, Tampa.
- Kilham, L. 1958. A snake-eating robin. *Auk* 75:352.
- Kilham, L. 1959. Early reproductive behavior of flickers. *Wilson Bulletin* 71:323-336.
- Kilham, L. 1959. Mutual tapping of the Red-headed Woodpecker. *Auk* 76:235-236.
- Kilham, L. 1959. Behavior and methods of communication of Pileated Woodpeckers. *Condor* 61:377-387.
- Kilham, L. 1976. Winter foraging and associated behavior of Pileated Woodpeckers in Georgia and Florida. *Auk* 93:15-24.

- Kilham, L. 1977. Early breeding season behavior of Red-headed Woodpeckers. *Auk* 94:231-239.
- Kilham, L. 1980. Dusting by Sandhill Cranes in Florida. *Florida Field Naturalist* 8:19-20.
- Kilham, L. 1980. Assemblages of Tree Swallows as information centers. *Florida Field Naturalist* 8:26-28.
- Kilham, L. 1980. Association of Great Egret and White Ibis. *Journal of Field Ornithology* 51:73-74.
- Kilham, L. 1980. Prenesting behavior of the Swallow-tailed Kite (*Elanoides forficatus*), including interference by an unmated male with a breeding pair. *Journal of Raptor Research* 14:29-31.
- Kilham, L. 1981. Red-shouldered Hawks whirling with talons locked in conflict. *Journal of Raptor Research* 15:123-124.
- Kilham, L. 1982. Cleaning/feeding symbioses of Common Crows with cattle and feral hogs. *Journal of Field Ornithology* 53:275-276.
- Kilham, L. 1982. Common Crows pulling the tail and stealing food from a river otter. *Florida Field Naturalist* 10:39-40.
- *Kilham, L. 1983. Life history studies of woodpeckers of eastern North America. Publications of the Nuttall Ornithological Club no. 20.
- Kilham, L. 1984. Intra- and extrapair copulatory behavior of American Crows. *Wilson Bulletin* 96:716-717.
- Kilham, L. 1984. Foraging and food storing of American Crows in Florida. *Florida Field Naturalist* 12:25-31.
- Kilham, L. 1984. Play-like behavior of American Crows. *Florida Field Naturalist* 12:33-36.
- Kilham, L. 1984. American Crows feeding on and storing river otter dung. *Florida Field Naturalist* 12:103-104.
- Kilham, L. 1984. American Crows robbing Great Egrets and White Ibis of large, eel-like salamanders. *Colonial Waterbirds* 7:143-145.
- Kilham, L. 1984. Cooperative breeding of American Crows. *Journal of Field Ornithology* 55:349-356.
- Kilham, L. 1985. Attacks on fawns, pigs, and other young or weakened mammals by American Crows. *Florida Field Naturalist* 13:17-18.
- Kilham, L. 1985. Some breeding season vocalizations of American Crows in Florida. *Florida Field Naturalist* 13:49-57.
- Kilham, L. 1985. Alligator with young threatens Great Blue Heron. *Florida Field Naturalist* 13:68-70.
- Kilham, L. 1985. American Crows provoking reactions from Wild Turkeys and Red-shouldered Hawks. *Florida Field Naturalist* 13:94-95.
- Kilham, L. 1986. Vocalizations by female American Crows early in the nesting period. *Journal of Field Ornithology* 57:309-310.
- *Kilham, L. 1989a. The American Crow and the Common Raven. Texas A&M University Press, College Station.
- Kilham, L. 1989b. An extraordinary bird. *Birder's World* 3:19-23.
- *Kinsella, J. M. 1974. Helminth fauna of the Florida Scrub Jay: host and ecological relationships. *Proceedings of the Helminthological Society of Washington* 41:127-130.
- Kittredge, M., and F. E. Lohrer. 1997. Birds of Highlands Hammock State Park [a check list]. Florida Park Service, Tallahassee, Florida.
- Knouff, R. A., and F. A. Hartman. 1951. A microscopic study of the adrenal of

- the Brown Pelican. *Anatomical Record* 109:161-188.
- *Kramer, D. A. 2000. Recaching facilitates cache recovery in the Florida Scrub-Jay: a "rolling horizon of short-term memory" model. M.S. thesis, University of Wisconsin, Madison.
- Kushlan, J. A. 1972. Status of the Red-headed Woodpecker (*Melanerpes erythrocephalus*) in south Florida. *Florida Naturalist* 45:27-28.
- Langridge, H. P., and G. E. Woolfenden. 1998. First record of the Thick-billed Murre from Florida. *Florida Field Naturalist* 26:88-89.
- *Lanyon, W. E. 1995. Ornithology at the American Museum of Natural History. Pp. 113-144 in W. E. Davis, Jr. and J. A. Jackson, eds., *Contributions to the History of North American Ornithology*. Memoirs of the Nuttall Ornithological Club no. 12.
- Layne, J. N. 1978. Audubon's Caracara. Pp. 26-27 in H. W. Kale II, ed., *Rare and Endangered Biota of Florida*. Vol. 2. Birds. University Presses of Florida, Gainesville.
- *Layne, J. N. 1980. Trends in numbers of American Kestrels on roadside counts in southcentral Florida from 1968 to 1976. *Florida Field Naturalist* 8:110.
- *Layne, J. N. 1981a. Nesting, development of the young, and parental behavior of a pair of Florida Sandhill Cranes. *Florida Field Naturalist* 9:51-59.
- *Layne, J. N. 1981b. Observations on wing molt of Florida Sandhill Cranes. *Florida Field Naturalist* 9:60-61.
- *Layne, J. N. 1982a. The Caracara in Florida. *Enfo Report* 82:10-12.
- *Layne, J. N. 1982b. Dry ground nests of Florida Sandhill Cranes. *Florida Field Naturalist* 10:55-56.
- *Layne, J. N. 1982c. Status of sibling aggression in Florida Sandhill Cranes. *Journal of Field Ornithology* 53:272-274.
- *Layne, J. N. 1982d. Analysis of Florida-related banding data for the American Kestrel. *North American Bird Bander* 7:94-99.
- *[Layne, J. N.] 1983a. Archbold Biological Station of Archbold Expeditions, Inc., 41st Annual Report, 1981-1982. Archbold Biological Station, Lake Placid, Florida.
- *Layne, J. N. 1983b. Productivity of Sandhill Cranes in south central Florida. *Journal of Wildlife Management* 47:178-185.
- *Layne, J. N. 1985. Audubon's Caracara. *Florida Wildlife* 39:40-42.
- *Layne, J. N. 1986. Observations on Cooper's Hawk nesting in south central Florida. *Florida Field Naturalist* 14:85-95.
- Layne, J. N. 1987. Prairie Falcon sighting in Florida. *Florida Field Naturalist* 15:79-80.
- *Layne, J. N. 1995. Audubon's Crested Caracara in Florida. Pp. 82-83 in E. T. LaRoe, G. S. Farris, C. E. Puckett, P. D. Doran, and M. J. Mac, eds., *Our Living Resources*. U.S. Department of the Interior, National Biological Service, Washington, D.C.
- *Layne, J. N. 1996. Crested Caracara (*Caracara plancus*). Pp. 197-210 in J. A. Rodgers, Jr., H. W. Kale II, and H. T. Smith, eds., *Rare and Endangered Biota of Florida*. Vol. V. Birds. University Press of Florida, Gainesville, Florida.
- Layne, J. N., and J. F. Douglass. 1976. Summer records of the Marsh Hawk in Florida. *Florida Field Naturalist* 4:19-21.
- Layne, J. N., F. E. Lohrer, and C. E. Winegarner. 1977. Bird and mammal pred-

- ators on the Cattle Egret in Florida. *Florida Field Naturalist* 5:1-4.
- *Layne, J. N., and D. R. Smith. 1992. Size comparisons of resident and wintering American Kestrels in south-central Florida. *Journal of Field Ornithology* 63:256-263.
- *Layne, J. N., J. A. Stallcup, G. E. Woolfenden, M. N. McCauley, and D. J. Worley. 1977. Fish and wildlife inventory of the seven-county region included in the central Florida phosphate industry areawide environmental impact study. Archbold Biological Station, Lake Placid, Florida. Final report submitted to Fish and Wildlife Service, U.S. Department of the Interior, Contract no. 14-16-009-77-005. (Available from: U.S. Department of Commerce, National Technical Information Services PB-278455SET, 3 Volumes, 1418 pp. PB-278456, Volume 1, 1-643. PB-278457, Volume 2, 644-1279. PB-278458, Volume 3, 1280-1418, Appendices A-G.).
- *LeClair, S. C. 2005. Comparison of hatching failure in a wildland and suburban population of the Florida Scrub-Jay (*Aphelocoma coerulescens*). M.S. thesis, University of South Florida, Tampa.
- Loftin, R. W., G. E. Woolfenden and J. A. Woolfenden. 1991. Florida bird records in American Birds and Audubon Field Notes (1947-1989). Florida Ornithological Society Special Publication no. 4.
- Lohrer, C. E., and F. E. Lohrer. 1984. Persistent predation by Swallow-tailed Kites on Eastern Kingbirds. *Florida Field Naturalist* 12:42-43.
- Lohrer, F. E. 1974. Some techniques used in a field study of Loggerhead Shrikes. *Bird-Banding* 45:361-362.
- Lohrer, F. E. 1977. Orchard Oriole holding food with the feet. *Florida Field Naturalist* 5:51.
- Lohrer, F. E. 1980. Eastern coachwhip predation on nestling Blue Jays. *Florida Field Naturalist* 8:28-29.
- Lohrer, F. E. 1984. Banded Royal Terns in inland Florida. *Florida Field Naturalist* 12:78.
- Lohrer, F. E. 1985. Ontogeny of thermoregulation in the Eastern Screech-Owl. *Journal of Field Ornithology* 56:65-66.
- Lohrer, F. E. 1990. Mature citrus orchard [winter bird population study]. *Journal of Field Ornithology* 61 (supplement):20.
- Lohrer, F. E. 1991. Mature citrus orchard [winter bird population study]. *Journal of Field Ornithology* 62 (supplement):26.
- Lohrer, F. E. 1991. Mature citrus orchard [breeding bird census]. *Journal of Field Ornithology* 62 (suppl.):86.
- *Lohrer, F. E. 1999. Archbold Biological Station biennial report 1997-1998. Archbold Biological Station, Lake Placid, Florida.
- Lohrer, F. E., K. Beck, and C. E. Winegarner. 1982. Checklist of birds of Highlands County, Florida. Highlands County Audubon Society, Lake Placid, Florida.
- *Lohrer, F. E., K. Beck, and C. E. Winegarner. 1987. Checklist of birds of Highlands County, Florida. Highlands County Audubon Society, Lake Placid, Florida.
- Lohrer, F. E., and C. E. Lohrer. 1971. Least Grebe (*Podiceps dominicus*) at Miami, Florida. *Florida Naturalist* 44:93.
- Lohrer, F. E., and C. E. Lohrer. 1973. Inland nesting of the Least Tern in Highlands County, Florida. *Florida Field Naturalist* 1:3-5.
- Lohrer, F. E., and C. E. Winegarner. 1980. Swallow-tailed Kite predation on

- nestling Mockingbird and Loggerhead Shrike. *Florida Field Naturalist* 8:47-48.
- *Lohrer, F. E., and G. E. Woolfenden. 1992. Birds of the Archbold Biological Station, Lake Placid, Florida. Archbold Biological Station, Lake Placid, Florida. <<http://www.archbold-station.org/abs/data/lists/birdlist.htm>>
- Maehr, D. S., and J. N. Layne. 1996. The saw palmetto. *Gulfshore Life* 26(7):38-41, 56-58.
- Maehr, D. S., and J. N. Layne. 1997. Florida's all-purpose plant - the saw palmetto. *The Palmetto* 16(4):6-10, 15, 21.
- *Martell, M. S., M. A. McMillian, M. J. Solensky, and B. K. Mealey. 2004. Partial migration and wintering use of Florida by Ospreys. *Journal of Raptor Research* 38:55-61.
- *Marzluff, J. M., R. Bowman, and R. Donnelly, eds. 2001. *Avian Conservation and Ecology in an Urbanizing World*. Kluwer Academic Publishers, Norwell, Massachusetts.
- Marzluff, J. M., R. Bowman, and R. Donnelly. 2001. A historical perspective on urban bird research: trends, terms, and approaches. Pp. 1-17 in J. M. Marzluff, R. Bowman, and R. Donnelly, eds., *Avian Conservation and Ecology in an Urbanizing World*. Kluwer Academic Publishers, Boston.
- *Marzluff, J. M., G. E. Woolfenden, J. W. Fitzpatrick, and R. P. Balda. 1996. Breeding partnerships of two New World jays. Pp. 138-161 in J. M. Black, ed., *Partnerships in Birds*. Oxford University Press, Oxford, United Kingdom.
- *Mayr, E. 1975. Epilogue: Materials for a history of American ornithology. Pp 365-396 in E. Stresemann, *Ornithology from Aristotle to the Present*. Harvard University Press, Cambridge, Massachusetts.
- McDonald, D. B., and H. Caswell. 1993. Matrix methods for avian demography. *Current Ornithology* 10:139-185.
- *McDonald, D. B., J. W. Fitzpatrick, and G. E. Woolfenden. 1996. Actuarial senescence and demographic heterogeneity in the Florida Scrub Jay. *Ecology* 77:2373-2381.
- *McDonald, D. B., W. K. Potts, J. W. Fitzpatrick, and G. E. Woolfenden. 1999. Contrasting genetic structures in sister species of North American scrub-jays. *Proceedings of the Royal Society of London B* 266:1117-1125.
- *McFadden, K. J. 1992. Time budgets, breeder survival, and cost of reproduction in the Florida Scrub Jay. Senior Honors thesis, Allegheny College, Meadville, Pennsylvania.
- *McGowan, K. J. 1987. Social development in young Florida Scrub Jays (*Aphelocoma c. coerulescens*). Ph.D. dissertation, University of South Florida, Tampa.
- McGowan, K. J., and G. E. Woolfenden. 1986. Aerial rain bathing by Common Nighthawks. *Wilson Bulletin* 98:612-613.
- *McGowan, K. J., and G. E. Woolfenden. 1989. A sentinel system in the Florida Scrub Jay. *Animal Behaviour* 37:1000-1006.
- *McGowan, K. J., and G. E. Woolfenden. 1990. Contributions to fledgling feeding in the Florida Scrub Jay. *Journal of Animal Ecology* 59:691-707.
- *McKittrick, M. C. 1979. Territory size and density of Bachman's Sparrow in south central Florida. *Florida Field Naturalist* 7:33-34.
- McMillian, M. A. 1998. "Foot-hunting" behavior by a Great Horned Owl. *Florida Field Naturalist* 26:91-93.

- McMillian, M. A., and B. Pranty. 1998. Recent nesting of the White-tailed Kite in central Florida. *Florida Field Naturalist* 25:143-145.
- *McMillian, M. A., and R. Yosef. 2001. Birds of Buck Island Ranch, Lake Placid, Florida: a checklist. Archbold Biological Station, Lake Placid, Florida <http://www.maerc.org/html/datapublications/biota_splist/birds.-html>
- McNair, D. B., M. A. McMillian, and L. M. Rojas. 2000. Attempted heterospecific kleptoparasitism by Crested Caracaras of Ospreys. *Florida Field Naturalist* 28:196-197.
- Mengel, R. M., R. S. Sharpe, and G. E. Woolfenden. 1972. Wing clapping in territorial and courtship behavior of the Chuck-will's-widow and Poorwill (Caprimulgidae). *Auk* 89:440-444.
- Menges, E. S. 1999. Ecology and conservation of Florida scrub. Pp. 7-22 in R. C. Anderson, J. S. Fralish, and J. M. Baskin, eds., *Savannahs, Barrens, and Rock Outcrop Plant Communities of North America*. Cambridge University Press, Cambridge, United Kingdom.
- Meshaka, Jr., W. E. 1994. Giant toad eaten by a Red-shouldered Hawk. *Florida Field Naturalist* 22:54-55.
- Midford, P. E. 1993. Cultural transmission is more than cultural learning. *Behavior and Brain Science* 16:529-530.
- *Midford, P. E. 1999. Social learning and tradition in the Florida Scrub-Jay (*Aphelocoma coerulescens*). Ph.D. dissertation, University of Wisconsin, Madison.
- *Midford, P. E., J. P. Hailman, and G. E. Woolfenden. 2000. Social learning of a novel foraging patch in families of free-living Florida Scrub-Jays. *Animal Behaviour* 59:1199-1207.
- *Moore, A. L. 1930. John D. Archbold and the Early Development of Standard Oil. McMillan, New York, pp.280-281.
- Morrison, J. L. 1996. Crested Caracara (*Caracara plancus*). Pp. 1-28 in A. Poole and F. Gill, eds., *The Birds of North America*, no. 249. Academy of Natural Sciences, Philadelphia and American Ornithologists' Union, Washington, D.C.
- *Morrison, J. L. 1997. Reproductive ecology and habitat association of Florida's Crested Caracara. Ph.D. dissertation, University of Florida, Gainesville.
- Morrison, J. L. 1998. Effects of double brooding on productivity in Crested Caracaras. *Auk* 115:979-987.
- Morrison, J. L. 1999. Breeding biology and productivity of Florida's Crested Caracaras. *Condor* 101:505-517.
- *Morrison, J. L. 2006. The Crested Caracara in the changing grasslands of Florida. Pp. 211-215 in R. F. Noss, ed., *Land of Fire and Water: The Florida Dry Prairie Ecosystem*. Proceedings of the Florida Dry Prairie Conference, October 5-7, 2004. Sebring, Florida
- Morrison, J. L., and M. Maltbie. 1999. Methods of gender determination in Crested Caracaras. *Journal of Raptor Research* 33:128-133.
- Morrison, J. L., and S. M. McGehee. 1996. Capture methods for Crested Caracaras. *Journal of Field Ornithology* 67:630-636.
- Morrison, J. L., M. A. McMillian, S. M. McGehee, and L. D. Todd. 1997. First record of Crested Caracaras nesting in a cypress. *Florida Field Naturalist* 25:51-53.

- *Morrison, J. L., and K. E. Pias. 2006. Assessing the vertebrate component of the diet of Florida's Crested Caracaras (*Caracara cheriway*). *Florida Scientist* 69:36-43.
- *Morse, R. A. 2000. Richard Archbold and the Archbold Biological Station. University Press of Florida, Gainesville.
- Moskovits, D. 1978. Winter territorial and foraging behavior of Red-headed Woodpeckers in Florida. *Wilson Bulletin* 90:521-535.
- Mumme, R. L. 1987. Eastern indigo snake preys on juvenile Florida Scrub Jay. *Florida Field Naturalist* 15:53-54.
- *Mumme, R. L. 1991. Helping behaviour in the Florida Scrub Jay: nonadaptation, exaptation, or adaptation? Pp. 1317-1324 in B. D. Bell, R. O. Cossee, J. E. C. Flux, B. D. Heather, R. A. Hitchmough, C. J. R. Robertson, M. J. Williams, eds., *Acta XX Congressus Internationalis Ornithologici*, Christchurch, New Zealand, 2-9 December 1990. New Zealand Ornithological Congress Trust Board, Wellington, New Zealand.
- *Mumme, R. L. 1992. Do helpers increase reproductive success? An experimental analysis in the Florida Scrub Jay. *Behavioral Ecology and Sociobiology* 31:319-328.
- *Mumme, R. L., and T. H. Below. 1999. Evaluation of translocation for the threatened Florida Scrub-Jay. *Journal of Wildlife Management* 63:833-842.
- *Mumme, R. L., S. J. Schoech, G. E. Woolfenden, and J. W. Fitzpatrick. 2000. Life in the fast lane: demographic consequences of road mortality in the Florida Scrub-Jay. *Conservation Biology* 14:501-512.
- Mumme, R. L., and G. E. Woolfenden. 1976. Tufted Titmouse feeds young in fallen external squirrel nest. *Florida Field Naturalist* 4:18.
- *Murray, B. G., J. W. Fitzpatrick, and G. E. Woolfenden. 1989. The evolution of clutch size. II. A test of the Murray-Nolan equation. *Evolution* 43:1706-1711.
- *Nelson, B. S. 1998. Accuracy of sound localization and spectro-temporal association with sound pressure level in calls of the Eastern Towhee. M.S. thesis, Florida International University, Miami.
- Nelson, B. S. 2000. Avian dependence on sound pressure level as an auditory distance cue. *Animal Behaviour* 59:57-67.
- Nelson, B. S., and P. K. Stoddard. 1998. Accuracy of auditory distance and azimuth perception by a passerine bird in natural habitat. *Animal Behaviour* 56:467-477.
- Nelson, B. S., and R. A. Suthers. 2004. Sound localization in a small passerine bird: discrimination of azimuth as a function of head orientation and sound frequency. *Journal of Experimental Biology* 2007:4121-4133.
- Paul, R. T., and G. E. Woolfenden. 1985. Current status and recent trends in bird populations of Tampa Bay. Pp. 426-447 in S-A. F. Treat, J. L. Simon, R. L. Lewis, III, and R. L. Whitman, Jr., eds., *Proceedings Tampa Bay Area Scientific Information Symposium*, May 1982. Bellwether Press, Tampa, Florida.
- Penner, L. R. 1961. Operation anhinga. *Zoonoos* 34:10-15.
- *Penner, L. R., and B. Fried. 1963. *Philophthalmus hegneri* sp. n., an ocular trematode from birds. *Journal of Parasitology* 49:974-977.
- *Penner, L. R., and J. J. Trimble. 1970. *Philophthalmus larsoni* sp. n., an ocular trematode from birds. University of Connecticut Occasional Papers. Biological Science Series 1:265-273.

- Peer, B. D., and S. G. Sealy. 2004. Fate of grackle (*Quiscalus* spp.) defenses in the absence of brood parasitism: implications for long-term parasite-host evolution. *Auk* 121:1172-1186.
- Peterson, A. T. 1993. Adaptive geographical variation in bill shape of scrub jays (*Aphelocoma coerulescens*). *American Naturalist* 142:508-527.
- *Pitelka, F. M. 1951. Speciation and ecologic distribution in the American jays of the genus *Aphelocoma*. University of California Publications in Zoology 50:195-464.
- Post, W., J. P. Poston, and G. T. Bancroft. 1996. Boat-tailed Grackle (*Quiscalus major*). Pp. 1-28 in A. Poole and F. Gill, eds., *The Birds of North America*, no. 207. Academy of Natural Sciences, Philadelphia and American Ornithologists' Union, Washington, D.C.
- Pranty, B. 1995. Tool use by Brown-headed Nuthatches in two Florida slash pine forests. *Florida Field Naturalist* 23:33-34.
- *Pranty, B. 1996. A birder's guide to Florida. American Birding Association, Colorado Springs, Colorado.
- *Pranty, B., J. W. Fitzpatrick, and B. Stith. 1998. Distribution of the Florida Scrub-Jay. 1992-1997. Unpublished MS on file at Archbold Biological Station.
- Pranty, B., A. W. Kratter, and R. Bowman. 2005. Records of the Bullock's Oriole in Florida. *Florida Field Naturalist* 33:41-46.
- Pranty, B., and M. A. McMillian. 1998. Status of the White-tailed Kite in northern and central Florida. *Florida Field Naturalist* 25:117-127.
- Pranty, B., and J. W. Tucker, Jr. 2006. Ecology and management of the Florida Grasshopper Sparrow. Pp. 188-200 in R. F. Noss, ed., *Land of Fire and Water: The Florida Dry Prairie Ecosystem*. Proceedings of the Florida Dry Prairie Conference, October 5-7, 2004. Sebring, Florida.
- Pranty, B., and G. E. Woolfenden. 2000. First record of the Northern Lapwing in Florida. *Florida Field Naturalist* 28:53-57.
- *Quinn, J. S., G. E. Woolfenden, J. W. Fitzpatrick, and B. N. White. 1999. Multi-locus DNA fingerprinting reveals strict monogamy in Florida Scrub-Jays. *Behavioral Ecology and Sociobiology* 45:1-10.
- *Rand, A. L. 1941. Arizona expedition. *Natural History* 48:232-235.
- *Rand, A. L. 1942. Results of the Archbold Expeditions. No. 44. Some notes on bird behavior. *Bulletin of the American Museum of Natural History* 79:517-524.
- *Rand, A. L. 1943. Bass eats yellowthroat, young stilts, and young ducks. *Auk* 60:95.
- Rand, A. L. 1956. Foot-stirring as a feeding habit of Wood Ibis and other birds. *American Midland Naturalist* 55:96-100.
- *Rand, A. L. 1976. Obituary: Richard Archbold. *Auk* 94:186-187.
- *Reynolds, S. J., S. J. Schoech, and R. Bowman. 2003a. Nutritional quality of prebreeding diet influences breeding performance of the Florida Scrub-Jay. *Oecologia* 134:308-316.
- *Reynolds, S. J., S. J. Schoech, and R. Bowman. 2003b. Diet quality during pre-laying and nestling periods influences growth and survival of Florida Scrub-Jay (*Aphelocoma coerulescens*) chicks. *Journal of Zoology, London*, 261:217-226.
- *Robertson, W. B., Jr., and G. E. Woolfenden. 1992. Florida bird species: an annotated list. Florida Ornithological Society Special Publication no. 6.

- Robinson, S. R. 1981. Head scratching and yawning in Black Skimmers. *Journal of Field Ornithology* 52:59-60.
- Rohwer, S. A., and G. E. Woolfenden. 1968. The varied diet of the Gull-billed Tern includes a shrub-inhabiting lizard. *Wilson Bulletin* 80:330-331.
- *Rohwer, S. A., and G. E. Woolfenden. 1969. Breeding birds of two Florida woodlands: comparisons with areas north of Florida. *Condor* 71:38-48.
- *Rowley, I. 1965. The life history of the Superb Blue Wren, *Malurus cyaneus*. *Emu* 64:251-297.
- *Rowley, I., S. T. Emlen, A. J. Gaston, and G. E. Woolfenden. 1979. A definition of group. *Ibis* 121:231.
- *Saul, L. J. 1983. Red-bellied Woodpecker responses to accipiters. *Wilson Bulletin* 95:490-491.
- *Saul, L. J., and D. A. Wassmer. 1983. Red-bellied Woodpeckers roosting outside of cavities. *Florida Field Naturalist* 11:50-51.
- *Sauter, A. 2005. Shall we feed suburban Florida Scrub-Jays *Aphelocoma coerulescens*? The importance of human-provided foods on parental food choice, nestling growth and survival. Ph.D. dissertation, University Zurich, Zurich, Switzerland.
- *Sauter, A., R. Bowman, S. J. Schoech, and G. Pasinelli. 2006. Does optimal foraging theory explain why suburban Florida Scrub-Jays (*Aphelocoma coerulescens*) feed their young human-provided food? *Behavioral Ecology and Sociobiology* 60:465-474.
- *Schaub, R. 1990. Predation on the eggs and nestlings of Florida Scrub Jays. M.S. thesis, University of South Florida, Tampa.
- *Schaub, R., R. L. Mumme, and G. E. Woolfenden. 1992. Predation on the eggs and nestlings of Florida Scrub Jays. *Auk* 109:585-593.
- *Schmidt-Nielsen, K., and R. Fange. 1958. The function of the salt gland in the Brown Pelican. *Auk* 75:282-289.
- *Schoech, S. J. 1995. Endocrine mechanisms of cooperative breeding in the Florida Scrub Jay (*Aphelocoma coerulescens*). Ph.D. dissertation, University of Washington, Seattle.
- *Schoech, S. J. 1996. The effect of supplemental food on body condition and the timing of reproduction in a cooperative breeder, the Florida Scrub-Jay. *Condor* 98:234-244.
- *Schoech, S. J. 1998. Physiology of helping in Florida Scrub-Jays. *American Scientist* 86:70-77.
- Schoech, S. J. 1999. Florida Scrub-Jay nestlings preyed upon by an eastern coachwhip. *Florida Field Naturalist* 27:57-58.
- *Schoech, S. J., and R. Bowman. 2001. Variation in the timing of breeding between suburban and wildland Florida Scrub-Jays: do physiological measures reflect different environments? Pp. 289-306 in J. M., R. Bowman, and R. Donnelly, eds., *Avian Conservation and Ecology in an Urbanizing World*. Kluwer Academic Publishers, Boston.
- *Schoech, S. J., and R. Bowman. 2003. Does differential access to protein influence differences in timing of breeding of Florida Scrub-Jays (*Aphelocoma coerulescens*) in suburban and wildland habitats? *Auk* 120:1114-1127.
- Schoech, S. J., R. Bowman, and S. J. Reynolds. 2004. Food supplementation and possible mechanisms underlying early breeding in the Florida Scrub-jay (*Aphelocoma coerulescens*). *Hormones and Behavior* 46:565-573.

- *Schoech, S. J., R. L. Mumme, and M. C. Moore. 1991. Reproductive endocrinology and mechanisms of breeding inhibition in cooperatively breeding Florida Scrub Jays (*Aphelocoma c. coerulescens*). *Condor* 93:354-364.
- *Schoech, S. J., R. L. Mumme, and J. C. Wingfield. 1996a. Prolactin and helping behaviour in the cooperatively breeding Florida Scrub-Jay, *Aphelocoma c. coerulescens*. *Animal Behaviour* 52:445-456.
- *Schoech, S. J., R. L. Mumme, and J. C. Wingfield. 1996b. Delayed breeding in the cooperatively breeding Florida Scrub-Jay (*Aphelocoma coerulescens*): inhibition or the absence of stimulation. *Behavioral Ecology and Sociobiology* 39:77-90.
- *Schoech, S. J., R. L. Mumme, and J. C. Wingfield. 1997. Corticosterone, reproductive status, and body mass in a cooperative breeder, the Florida Scrub-Jay (*Aphelocoma coerulescens*). *Physiological Zoology* 70:68-73.
- Schoech, S. J., S. J. Reynolds, and R. K. Boughton. 2004. Endocrinology. Pp. 128-141 in W. J. Koenig and J. Dickenson, eds., *Ecology and Evolution of Cooperative Breeding in Birds*. Cambridge University Press, Cambridge, United Kingdom.
- *Schreiber, E. A., C. J. Feare, B. A. Harrington, B. G. Murray, Jr., W. B. Robertson, Jr., M. J. Robertson, and G. E. Woolfenden. 2002. Sooty Tern *Sterna fuscata*. Pp. 1-30 in A. Poole and F. Gill, eds., *The Birds of North America*, no. 666. American Ornithologists' Union, Washington, D.C. and Cornell Lab of Ornithology, Ithaca, New York.
- Schreiber, R. W., G. E. Woolfenden, and W. E. Curtsinger. 1975. Prey capture by the Brown Pelican. *Auk* 92:649-654.
- Schwalm, D. L., and R. Bowman. 2004. Inbreeding depression or resource limitation: patterns of variation in hatching failure in Red-cockaded Woodpeckers at Avon Park Air force Range. P. 630 in R. Costa and S. J. Daniels, eds., *Red-cockaded Woodpecker: Road to Recovery*. Hancock House Publishers, Blaine, Washington.
- *Shawkey, M. D. 2001. Proximate causes of brood reduction in Florida Scrub-Jays. M.S. thesis, University of South Florida, Tampa.
- *Shawkey, M. D., R. Bowman, and G. E. Woolfenden. 2004. Why is brood reduction in Florida Scrub-Jays higher in suburban than in wildland habitats? *Canadian Journal of Zoology* 82:1427-1435.
- Sheridan, M. N., W. D. Belt, and F. A. Hartman. 1963. The fine structure of the interrenal cells of the Brown Pelican. *Acta Anatomica* 53:55-65.
- *Skutch, A. F. 1935. Helpers at the nest. *Auk* 52:257-273.
- *Skutch, A. F. 1961. Helpers among birds. *Condor* 63:198-226.
- *Smallwood, J. A. 1987a. Winter territoriality and predation ecology of American Kestrels (*Falco sparverius*) in southcentral Florida. Ph.D. dissertation, Ohio State University, Columbus.
- Smallwood, J. A. 1987b. Sexual segregation by habitat in American Kestrels wintering in southcentral Florida: vegetative structure and responses to differential prey availability. *Condor* 89:842-849.
- Smallwood, J. A. 1988. The relationship of vegetative cover to daily rhythms of prey consumption by American Kestrels wintering in southcentral Florida. *Journal of Raptor Research* 22:77-80.
- Smallwood, J. A. 1989. Prey preferences of free-ranging American Kestrels, *Falco sparverius*. *Animal Behaviour* 38:712-728.

- Smallwood, J. A. 1989. Age determination of American Kestrels: a revised key. *Journal of Field Ornithology* 60:510-519.
- *Smith, D. R. 1988. Differential habitat use by male and female American Kestrels (*Falco sparverius*) wintering in southcentral Florida and a proposed mechanism for sexual habitat segregation in the species. M.S. thesis, University of South Florida, Tampa.
- Smith, D. R., and J. N. Layne. 1986. Occurrence of a double brood in Red-headed Woodpeckers in south central Florida. *Florida Field Naturalist* 14:98-99.
- *Smith, P. W., and G. E. Woolfenden. 1995. Status of the Northern Wheatear in Florida. *Florida Field Naturalist* 23:93-96.
- Smith, P. W., G. E. Woolfenden, and A. Sprunt IV. 2000. The Loggerhead Kingbird in Florida: the evidence revisited. *North American Birds* 54:235-240.
- Snyder, N. F. R., J. C. Ogden, J. D. Bittner, and G. A. Grau. 1984. Larval dermestid beetles feeding on nestling Snail Kites, Wood Storks, and Great Blue Herons. *Condor* 86:170-174.
- *Stallcup, J. A. 1976. Helping behavior and the sex and age of Florida Scrub Jays. M.S. thesis, University of South Florida, Tampa.
- *Stallcup, J. A., and G. E. Woolfenden. 1978. Family status and contributions to breeding by Florida Scrub Jays. *Animal Behaviour* 26:1144-1156.
- Stedman, S. J., and F. E. Lohrer. 1976. A Tropical Kingbird sighting from the Florida panhandle. *Florida Field Naturalist* 4:40-41.
- *Stenzler, L. 2001. Genetic population structure in two bird species with contrasting dispersal behavior: the Tree Swallow and the Florida Scrub-Jay. M.S. thesis, Cornell University, Ithaca, New York.
- *Stenzler, L., and J. W. Fitzpatrick. 2002. Isolation of microsatellite loci in the Florida Scrub-Jay *Aphelocoma coerulescens*. *Molecular Ecology Notes* 2:547-550.
- *Stevenson, H. M. 1978. The populations of Boat-tailed Grackles in the southeastern United States. *Proceedings of the Biological Society of Washington* 91:27-51.
- Stevenson, H. M., E. Eisenmann, C. Winegarner, and A. Karlin. 1983. Notes on Common and Antillean nighthawks of the Florida Keys. *Auk* 100:983-988.
- *Stith, B. M. 1999. Metapopulation dynamics and landscape ecology of the Florida Scrub-Jay, *Aphelocoma coerulescens*. Ph.D. dissertation, University of Florida, Gainesville.
- *Stith, B. M., J. W. Fitzpatrick, G. E. Woolfenden, and B. Pranty. 1996. Classification and conservation of metapopulations: a case study of the Florida Scrub Jay. Pp. 187-215 in D. R. McCullough, ed., *Metapopulations and Wildlife Conservation*. Island Press, Washington, D.C.
- *Stoddard, Jr., H. L. 1969. *Memoirs of a naturalist*. University of Oklahoma Press, Norman.
- *Stotz, D. F., J. W. Fitzpatrick, T. A. Parker, III, and D. K. Moskovits. 1996. *Neotropical birds: ecology and conservation*. University of Chicago Press, Chicago, Illinois.
- Tarvin, K. A. 1994. Long-eared Owl observed in Highlands County, Florida. *Florida Field Naturalist* 22:110-111.
- *Tarvin, K. A. 1998. The influence of habitat variation on demography of Blue Jays (*Cyanocitta cristata*) in south-central Florida. Ph.D. dissertation,

University of South Florida, Tampa.

- Tarvin, K. A., and M. A. Garvin. 2002. Habitat and nesting success of Blue Jays (*Cyanocitta cristata*): importance of scale. *Auk* 119:971-983.
- Tarvin, K. A., M. C. Garvin, J. M. Jawor, and K. A. Dayer. 1998. A field estimation of techniques used to estimate density of Blue Jays. *Journal of Field Ornithology* 69:209-222.
- *Tarvin, K. A., and G. E. Woolfenden. 1997. Patterns of dominance and aggressive behavior in Blue Jays at a feeder. *Condor* 99:434-444.
- *Tarvin, K. A., and G. E. Woolfenden. 2000. Blue Jay (*Cyanocitta cristata*) Pp. 1-32 in A. Poole and F. Gill, eds., *The Birds of North America*, no. 469. Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, D.C.
- *Tate, G. M. 1946. Guba was a flying boat. *Collier's Magazine*, June 1, 1946, p. 56.
- *Thaxton, J. E., and T. H. Hingten. 1996. Effects of suburbanization and habitat fragmentation on Florida Scrub-Jay dispersal. *Florida Field Naturalist* 24:25-37.
- *Thorington, K. K., and R. Bowman. 2003. Predation rate on artificial nests increases with human housing density in suburban habitats. *Ecography* 26:188-196.
- Tiersch, T. R., and R. L. Mumme. 1993. An evaluation of the use of flow cytometry to identify sex in the Florida Scrub Jay. *Journal of Field Ornithology* 64:18-26.
- Titus, R. C. 1993. Fish Crows chase Tree Swallows. *Florida Field Naturalist* 21:34-35.
- *Taylor, M. A., D. Amadon, and W. E. Godfrey. 1984. In memoriam: Austin L. Rand. *Auk* 101:600-602.
- Tucker, J. W., and R. Bowman. 2006. Characteristics of Florida Grasshopper Sparrow habitat across a gradient of population abundance and persistence at Avon — Air Force Range. Pp. 203-210 in R. Noss, ed., *Land and Fire and Water: The Florida Dry Prairie Ecosystem*. Proceedings of the Florida Dry Prairie Conference, University Presses of Florida, Gainesville.
- *Valligny, C. D. 2003. Effects of an intense winter fire on Florida Scrub-Jay (*Aphelocoma coerulescens*) habitat use. M.S. thesis, Villanova University, Villanova, Pennsylvania.
- Van Nieuwenhuyse, D., P. Busse, R. Yosef, L. Fornasari, N. Lefranc, and F. Lohrer. 2000. Introduction to the 3rd international shrike symposium, 15-18 September 1999, Gdansk, Poland. *Ring* 22:5-10.
- Wallace, M. P., P. G. Parker, and S. A. Temple. 1980. An evaluation of patagial markers for cathartid vultures. *Journal of Field Ornithology* 51:309-314.
- *Wallace, M. P., and S. A. Temple. 1983. An evaluation of techniques for releasing hand-reared vultures to the wild. Pp. 400-423 in S. R. Wilbur and J. A. Jackson, eds., *Vulture Biology and Management*. University of California Press, Berkeley.
- *Walton, L. M. 1997. Florida Scrub-Jay nest-site selectivity in unfragmented, periodically burned vs. fragmented, overgrown habitat. M.S. thesis, Villanova University, Villanova, Pennsylvania.
- Webber, T. A. 1980. Eastern coachwhip predation on juvenile Scrub Jays. *Florida Field Naturalist* 8:29-30.
- Werner, H. W., and G. E. Woolfenden. 1983. The Cape Sable Sparrow: its habi-

- tats, habits, and history. Pp. 55-75 in T. L. Quay, J. B. Funderburg, Jr., D. L. Lee, E. F. Potter, C. S. Robbins, eds., *The Seaside Sparrow, Its Biology and Management*. Occasional Papers of the North Carolina Biological Survey, 1983-1985. North Carolina State Museum of Natural History, Raleigh, North Carolina.
- *Westcott, P. W. 1970. Ecology and behavior of the Florida Scrub Jay. Ph.D. dissertation, University of Florida, Gainesville.
- White, S. C., and G. E. Woolfenden. 1973. Breeding of the Eastern Bluebird in central Florida. *Bird-Banding* 44:110-123.
- Wiley, J. W., and F. E. Lohrer. 1973. Additional records of nonfish prey taken by Ospreys. *Wilson Bulletin* 85:468-470.
- *Woolfenden, G. E. 1969. [Breeding birds of three scrub habitats in Florida. Five breeding-bird censuses.] *Audubon Field Notes* 23:732-738.
- *Woolfenden, G. E. 1970. [Winter bird populations in Florida scrub and Slash Pine-Turkey Oak habitats. Five winter bird-population studies.] *Audubon Field Notes* 24:559-561.
- *Woolfenden, G. E. 1973. Nesting and survival in a population of Florida Scrub Jays. *Living Bird* 12:25-49.
- Woolfenden, G. E. 1975. Disting by a Red-bellied Woodpecker. *Florida Field Naturalist* 3:51.
- *Woolfenden, G. E. 1975. Florida Scrub Jay helpers at the nest. *Auk* 92:1-15.
- *Woolfenden, G. E. 1976a. Co-operative breeding in American birds. Pp. 674-684 in H. J. Frith and J. H. Calaby, eds., *Proceedings of the 16th International Ornithological Congress, Canberra, Australia, 12-17 August 1974*. Australian Academy of Science, Canberra City, Australia.
- *Woolfenden, G. E. 1976b. A case of bigamy in the Florida Scrub Jay. *Auk* 93:443-450.
- *Woolfenden, G. E. 1978a. Florida Scrub Jay. Pp. 45-47 in H. W. Kale, II, ed., *Rare and Endangered Biota of Florida*. Vol. 2, Birds. University Presses of Florida, Gainesville.
- *Woolfenden, G. E. 1978b. Growth and survival of young Florida Scrub Jays. *Wilson Bulletin* 90:1-18.
- Woolfenden, G. E. 1978. Snowy Plover. Pp. 8-9 in H. W. Kale II, ed., *Rare and Endangered Biota of Florida*. Vol. 2, Birds. University Presses of Florida, Gainesville, Florida.
- Woolfenden, G. E. 1978. Piping Plover, Pp. 88-89 in H. W. Kale, II, ed., *Rare and Endangered Biota of Florida*. Vol. 2, Birds. University Presses of Florida, Gainesville.
- Woolfenden, G. E. 1979. Winter breeding by the American Coot at Tampa, Florida. *Florida Field Naturalist* 7:26.
- *Woolfenden, G. E. 1981. Selfish behavior by Florida Scrub Jay helpers. Pp. 257-260 in R. A. Alexander and D. W. Tinkle, eds., *Natural Selection and Social Behavior*. Chiron Press, New York.
- *Woolfenden, G. E. 1983. Rare, threatened, and endangered vertebrates of southwest Florida and potential OCS activity impacts. U.S. Fish and Wildlife Service, Division of Biological Services, Washington, D.C., FWS/OBS-82-03.
- Woolfenden, G. E. 1994. North Pinellas Christmas Bird Count, 1985. *Florida Field Naturalist* 22:83-84.
- *Woolfenden, G. E. 2001. In memoriam: William B. Robertson, Jr., 1924-2000.

- Auk 118:740-742.
- Woolfenden, G. E., and R. C. Banks. 2004. A specimen of the Varied Thrush from Florida. *Florida Field Naturalist* 32:48-50.
- Woolfenden, G. E., and R. Bowman. 1997. A thrush/thrasher mixup. *Eagle's View* 7(5):3.
- Woolfenden, G. E., and M. V. Deventer. 2006. First record of the Varied Bunting from Florida. *Florida Field Naturalist* 34:1-3.
- *Woolfenden, G. E., and J. W. Fitzpatrick. 1977. Dominance in the Florida Scrub Jay. *Condor* 79:1-12.
- *Woolfenden, G. E., and J. W. Fitzpatrick. 1978a. The inheritance of territory in group-breeding birds. *BioScience* 28:104-108.
- *Woolfenden, G. E., and J. W. Fitzpatrick. 1978b. Avian heirs of territory. Authors' reply. *BioScience* 28:752.
- *Woolfenden, G. E., and J. W. Fitzpatrick. 1980. The selfish behavior of avian altruists. Pp. 886-889 in R. Nohring, ed., *Acta XVII Internationalis Ornithologici*. Berlin, Germany.
- *Woolfenden, G. E., and J. W. Fitzpatrick. 1984. *The Florida Scrub Jay: demography of a cooperative-breeding bird*. Princeton University Press, Princeton, New Jersey.
- *Woolfenden, G. E., and J. W. Fitzpatrick. 1985a. Demography of a communal breeder: the Florida Scrub Jay. *National Geographic Society Research Report* 19:723-724.
- *Woolfenden, G. E., and J. W. Fitzpatrick. 1985b. Growth of territories in the Florida Scrub Jay. P. 1036 in V. D. Ilyichev and V. M. Gavrilov, eds., *Acta XVIII Congressus Internationalis Ornithologicus*. Moscow, USSR.
- *Woolfenden, G. E., and J. W. Fitzpatrick. 1986. Sexual asymmetries in the life history of the Florida Scrub Jay. Pp. 87-107 in D. Rubenstein, D. and R. W. Wrangham, eds., *Ecological Aspects of Social Evolution: Birds and Mammals*. Princeton University Press, Princeton, New Jersey.
- *Woolfenden, G. E., and J. W. Fitzpatrick. 1990. Florida Scrub Jays: a synopsis after 18 years of study. Pp. 239-266 in P. B. Stacey and W. D. Koenig, eds., *Cooperative Breeding in Birds: Long-term Studies of Ecology and Behavior*. Cambridge University Press, Cambridge, United Kingdom.
- *Woolfenden, G. E., and J. W. Fitzpatrick. 1991. Florida Scrub Jay ecology and conservation. Pp. 542-565 in C. M. Perrins, J.-D. Lebreton, and G. J. M. Hiron, eds., *Bird Population Studies: Relevance to Conservation and Management*. Oxford University Press, Oxford, United Kingdom.
- *Woolfenden, G. E., and J. W. Fitzpatrick. 1996a. Florida Scrub-Jay *Aphelocoma coerulescens*. Pp. 267-280 in J. A. Rodgers, Jr., H. W. Kale II and H. T. Smith, eds., *Rare and Endangered Biota of Florida*. Vol. V, Birds. University Press of Florida, Gainesville.
- *Woolfenden, G. E., and J. W. Fitzpatrick. 1996b. Florida Scrub-Jay (*Aphelocoma coerulescens*). Pp. 1-28 in A. Poole and F. Gill, eds., *The Birds of North America*, no. 228. Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, D.C.
- Woolfenden, G. E., and J. S. Greenlaw. 2005. Specimen evidence for the occurrence of both Gray-cheeked and Bicknell's thrushes in Florida. *Florida Field Naturalist* 33:93-101.
- Woolfenden, G. E., and H. W. Kale II. 1974. A Black-capped Petrel specimen from Florida. *Florida Field Naturalist* 2:17-18.

- Woolfenden, G. E., and F. E. Lohrer. 1968. Great Cormorant seen on Old Tampa Bay, Florida. *Florida Naturalist* 41:169.
- Woolfenden, G. E., and A. J. Meyerriecks. 1963. Caspian Tern breeds in Florida. *Auk* 80:365-366.
- Woolfenden, G. E., L. R. Monteiro, and R. A. Duncan. 2001. Recovery from the northeastern Gulf of Mexico of a Band-rumped Storm-Petrel banded in the Azores. *Journal of Field Ornithology* 72:62-65.
- Woolfenden, G. E., B. Pranty, J. W. Fitzpatrick, and B. S. Nelson. 1996. Western Wood-Pewee recorded in Highlands County, Florida. *Florida Field Naturalist* 24:61-67.
- Woolfenden, G. E., and S. L. Olson. 2006. A specimen of a migrant Clapper Rail from the interior of southern Florida. *Florida Field Naturalist* 34:52-53.
- Woolfenden, G. E., and W. B. Robertson, Jr. 1974. Least Terns nest at Dry Tortugas. *Florida Field Naturalist* 2:19-20.
- Woolfenden, G. E., and W. B. Robertson, Jr. 1975. First nesting of the House Sparrow at Dry Tortugas. *Florida Field Naturalist* 3:23-24.
- Woolfenden, G. E., and W. B. Robertson, Jr. 1991. A banded Red Knot seen at the Dry Tortugas. *Florida Field Naturalist* 19:106-107.
- *Woolfenden, G. E., and W. B. Robertson, Jr. 2006. The breeding birds of Florida. Part I: Sources and post-settlement changes. *Florida Ornithological Society Special Publication* no. 7.
- Woolfenden, G. E., W. B. Robertson, Jr., and B. Pranty. 1996. Comparing the species lists in two recent books on Florida birds. *Florida Field Naturalist* 24:10-14.
- *Woolfenden, G. E. (compiler), H. M. Robertson, H. L. Shoffner, C. F. Sumner, H. Werner, and C. E. Winegarner. 1968a. Live oak-cabbage palm hammock [winter bird-population study]. *Audubon Field Notes* 22:488.
- *Woolfenden, G. E. (compiler), H. M. Robertson, C. F. Sumner, and H. W. Werner. 1968b. Live oak-cabbage palm hammock [breeding-bird census]. *Audubon Field Notes* 22:684.
- Woolfenden, G. E., and S. A. Rohwer. 1969. Breeding birds in a Florida suburb. *Bulletin of the Florida State Museum* 13:1-83.
- Woolfenden, G. E., and S. A. Rohwer. 1969. Bird populations in the suburbs and two woodland habitats in Pinellas County, Florida. Pp. 101-109 in *Florida State Board of Health Monograph* no. 12.
- Woolfenden, G. E., and S. A. Rohwer. 1969. Relative abundance of bird populations in residential suburbs in the Tampa Bay area of Florida. Pp. 110-117 in *Florida State Board of Health Monograph* no. 12.
- *Woolfenden, G. E. (compiler), S. A. Rohwer, J. A. Stevenson, C. F. Sumner, and C. E. Winegarner. 1967. Live oak-cabbage palm hammock [breeding bird census]. *Audubon Field Notes* 21:635-637.
- Woolfenden, G. E., and R. W. Schreiber. 1974. Lesser Black-backed Gulls in Florida. *Florida Field Naturalist* 2:20-21.
- Woolfenden, G. E., and R. W. Schreiber. 1973. The common birds of the saline habitats of the eastern Gulf of Mexico: their distribution, seasonal status, and feeding ecology. Pp. IIIJ-1-IIIJ-21 in J. I. Jones, R. E. Ring, M. O. Rinkel, and R. E. Smith, eds., *A Summary of Knowledge of the Eastern Gulf of Mexico*. State University System of Florida, Institute of Oceanography, St. Petersburg.
- Woolfenden, G. E., and M. van Deventer. 2006. First record of the Varied

- Bunting from Florida. *Florida Field Naturalist* 34:1-3.
- Woolfenden, G. E., S. C. White, R. L. Mumme, and W. B. Robertson, Jr. 1976. Aggression among starving Cattle Egrets. *Bird-Banding* 47:48-53.
- Woolfenden, G. E., and C. E. Winegarner. 1972. Homing by wintering Hermit Thrushes. *Bird-Banding* 43:54.
- Woolfenden, G. E., and J. A. Woolfenden. 1984. Ruddy Duck breeds in Tampa. *Florida Field Naturalist* 12:32-33.
- *Yosef, R. 1992a. Territoriality, nutritional condition, and conservation in Loggerhead Shrikes (*Lanius ludovicianus*). Ph.D. dissertation, Ohio State University, Columbus.
- Yosef, R. 1992. Loggerhead Shrikes eat crayfish. *Florida Field Naturalist* 20:75-76.
- Yosef, R. 1992. Behavior of polygynous and monogamous Loggerhead Shrikes, and a comparison with Northern Shrikes. *Wilson Bulletin* 104:747-749.
- Yosef, R. 1993. Prey transport by Loggerhead Shrikes. *Condor* 95:83-84.
- Yosef, R. 1994a. Sex-related differences in distraction displays by Florida Sandhill Cranes. *Condor* 96:222-224.
- Yosef, R. 1994b. The effects of fencelines on the reproductive success of Loggerhead Shrikes. *Conservation Biology* 8:281-285.
- Yosef, R. 1994c. Conservation commentary. An evaluation of the global decline in the true shrikes (family Laniidae). *Auk* 111:228-233.
- Yosef, R. 2000. The Mayfield method for standardisation of shrike breeding studies: the case of the Loggerhead Shrike (*Lanius ludovicianus*) in south-central Florida. *Ring* 22:111-121.
- Yosef, R. 2001. Nesting ecology of resident Loggerhead Shrikes in south-central Florida. *Wilson Bulletin* 113:279-284.
- Yosef, R., J. E. Carrell, and T. Eisner. 1996. Contrasting reactions of Loggerhead Shrikes to two types of chemical defended insect prey. *Journal of Chemical Ecology* 22:173-181.
- Yosef, R., and M. A. Deyrup. 1994. Pellet analysis of Burrowing Owls in south central Florida. *Florida Field Naturalist* 22:78-80.
- Yosef, R., and M. A. Deyrup. 1998. Effects of fertilizer-induced reduction of invertebrates on reproductive success of Loggerhead Shrikes (*Lanius ludovicianus*). *Journal für Ornithologie* 139:307-312.
- Yosef, R., and T. C. Grubb, Jr. 1992. Territory sizes influences nutritional condition in non-breeding Loggerhead Shrikes: a ptilochronology approach. *Conservation Biology* 6:447-449.
- Yosef, R., and T. C. Grubb, Jr. 1993. Effect of vegetation height on hunting behavior and diet of Loggerhead Shrikes. *Condor* 95:127-131.
- Yosef, R., and T. C. Grubb, Jr. 1994. Resource dependency and territory size in Loggerhead Shrikes. *Auk* 111:465-469.
- Yosef, R., and T. C. Grubb, Jr. 1995. Ptilochronology: A potential biomarker for assessing territory quality and habitat suitability in shrikes. *Proceedings of the Western Foundation of Vertebrate Zoology* 6:276-279.
- *Yosef, R., J. N. Layne, and F. E. Lohrer. 1993. Trends in numbers of Loggerhead Shrikes on roadside censuses in peninsular Florida, 1974-1992. *Florida Scientist* 56:92-97.
- Yosef, R., and F. E. Lohrer. 1992. A composite treadle-bal chatrri trap for Loggerhead Shrikes. *Wildlife Society Bulletin* 20:116-118.

- Yosef, R., and F. E. Lohrer. 1995. Loggerhead Shrikes, red fire ants, and red herrings. *Condor* 97:1053-1056.
- Yosef, R., and F. E. Lohrer, eds. 1995. Shrikes (Laniidae) of the world: biology and conservation. *Proceedings of the Western Foundation of Vertebrate Zoology* 6:1-343.
- Yosef, R., and F. E. Lohrer, eds. 1998. Shrikes of the world - II: Conservation implications. *International Birdwatching Center Technical Publications* 7:1-119.
- Yosef, R., F. E. Lohrer, and P. Tryjanowski, eds. 2004. Special Volume: Advances in Shrikeology: the 4th International Shrike Symposium, Chemnitz, Germany, 17-18 August 2003. *Biological Letters* 41(2):59-197. <<http://www.biollett.amu.edu.pl/vol41.htm>>
- Yosef, R., F. E. Lohrer, D. Van Nieuwenhuyse, and P. Busse, eds. 2001. *Proceedings of the 3rd International Shrike Symposium*. Ring 22:1-217.
- Yosef, R., and D. Whitman. 1992. Predator exaptations and defensive adaptations in evolutionary balance: no defense is perfect. *Evolutionary Ecology* 6:527-536.
- Yosef, R., and D. Yosef. 1992. Observations on the behavior of Audubon's Crested Caracara. *Journal of Raptor Research* 26:100-101.
- Yosef, R., and P. Zduniak. 2004. Within-clutch variation in egg dimensions of Loggerhead Shrike (*Lanius ludovicianus*) in south-central Florida. *Biological Letters* 41:155-162. Available online at: http://www.staff.amu.edu.pl/~biollett/biollett_41_2_12.pdf
- *Zusi, R. L. 1987. A feeding adaptation of the jaw articulation in New World jays (Corvidae). *Auk* 104:665-680.

Ornithology in Delaware and the Delaware Museum of Natural History

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ABSTRACT. -Delaware's ornithological history begins with the earliest European exploration of the middle Atlantic region of the North American continent. Dutch and English explorers left lists of wildlife they observed. Eighteenth century observations are few and include only northern Delaware. Nineteenth century observations include those of Alexander Wilson, Thomas Nuttall, and John Cassin. Samuel N. Rhoades and Charles J. Pennock established ornithology in Delaware with their publication in 1905 of the first comprehensive bird list for the state. In the early twentieth century few people recorded their bird observations and recreational birding grew slowly. In 1963 a group of DuPont Company chemists and other interested birders formed the Delmarva Ornithological Society.

John E. du Pont founded the Delaware Museum of Natural History (DMNH) in 1957. Construction for DMNH began in 1969 and the building opened to the public in 1972. In its short history the Museum has amassed significant collections of Philippine and Mexican birds. Books on Philippine, South Pacific, and Delaware birds have been published based on specimens and records in DMNH's care.

EARLY HISTORY OF DELAWARE ORNITHOLOGY

Ornithology in Delaware has a long history, a detailed summary of which can be found in *Birds of Delaware* (Inskip 2000). Early Dutch explorers in 1631 named a settlement Swanendael (or Zwaanendael), or Valley of the Swans near present day Lewes, Delaware, apparently for swans seen wintering or migrating there (Jameson 1909). The English sea captain Thomas Yong, who in 1634 explored the Delaware Bay and River to the falls at present-day Trenton, New Jersey, listed or made reference to a minimum of 13 species (Myers 1912). Peter Lindestrom in

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1654-1655 (Lindestrom 1925), William Penn in 1698 (Myers 1912), and Gabriel Thomas in 1698 (Myers 1912) made other lists of birds seen in what is now Delaware. Thomas Campanius Holm published his own observations on New Sweden in 1702 (translated into English in 1834), based on the observations of his grandfather Johannes Holm from 1642 to 1648. Primary sources from the 18th century include Andreas Hesselius (1711-1724), the rector at Holy Trinity (Old Swedes) Church in Wilmington (Hesselius 1947), and Peter Kalm, a student of Linnaeus, who arrived in America in 1748 and made observations in the vicinity of Wilmington (Kalm 1937).

Alexander Wilson arrived in America at New Castle, Delaware, on 14 July 1794 (Cantwell 1961) and made references to Delaware birds in his *American Ornithology* (Wilson and Bonaparte, 1859-1860). Thomas Nuttall visited Delaware in 1809 and 1829, primarily for botanical collecting, and commented on the crow roost at Pea Patch Island and on Whip-poor-wills (*Caprimulgus vociferus*) that kept him awake at night (Nuttall 1832-1834, McDowell 1989). John Cassin collected the state's first Prothonotary Warbler (*Protonotaria citrea*) (Turnbull 1869). Walter Danforth Bush, a Wilmington businessman (1851-1904), kept a journal that listed birds he observed and collected from 1879 to 1881 (Bush 1878-1881). His surviving specimens are at the Delaware Museum of Natural History (DMNH).

Charles J. Pennock (1857-1935) made the first substantive contribution to Delaware ornithology. In 1904 he was named Delaware's first (and, to date, only) state ornithologist. With Samuel N. Rhoads (a noted ornithologist and mammalogist), he compiled the first comprehensive list for the state (Rhoades and Pennock 1905). Pennock's specimens are housed at DMNH and the Academy of Natural Sciences, Philadelphia (ANSP) (see Palmer et al. 1954, for biographies of Rhoades and Pennock). In his later years Pennock corresponded with the state chemist Herman H. Hanson and with a young ornithologist, John H. Buckalew (1912-1992) who had published records of Delaware birds (e.g., Buckalew 1933, 1934). Hanson recorded the bird life of Kent County from the 1920s to the early 1940s. Hanson's correspondents also included Buckalew and John Herholdt, the first refuge manager at Bombay Hook National Wildlife Refuge (founded 1937).

A BROAD VIEW OF RECENT ORNITHOLOGY IN DELAWARE

Recreational birding in Delaware grew at the same pace as it did in the nation at large. This is seen clearly both in the rise in number of Christmas Bird Counts (CBCs) held in the state and in the number of participants on those counts (Table 1). Delawareans began organizing to study birds as early as Pennock's time. The Society of Natural History

Table 1. Growth of Christmas Bird Counts in Delaware.

PERIOD	Number of count circles	Number of counts conducted	Average number of observers per count	Average number of party hours per count
1907-1939	10	13	2.6	8
1940-1949	3	15	16.1	43.2
1950-1959	3	25	13.2	62.2
1960-1969	5	39	23.3	76
1970-1979	5	50	30.5	98.5
1980-1989	5-6	57	30.5	80
1990-1999	6	60	31.6	91.1
2000-2007	6-7	55	33.3	93

of Delaware was established in 1891. Its focus appears to have been primarily on plants, insects, and minerals. However, there were ornithological programs by Walter D. Bush and field trips led by Charles J. Pennock (Jones 1950). The Society is currently most closely associated with the Claude E. Phillips Herbarium at Delaware State University, Dover, Delaware, although during the 1950s many of its members were birdwatchers, some of whom went on to form the Delmarva Ornithological Society (Brooks 1973).

Several Delaware bird clubs were formed in the 1940s and 1950s. The Dover Bird Club is known only from a letter to Herman H. Hanson (Inskip 2000). In the late 1940s a group of chemists formed an informal birding club known as the "Speed Marvel Bird Watching Association" to make organized birding trips when the eminent University of Illinois polymer chemist and avid birder Carl S. Marvel was in town (Brooks 1973, Inskip 2000). The Newark Bird Club was formed by Sarah E. Potts in the late 1940s and later became affiliated with the Delaware Audubon Society. The Lattonikan (a Lenape Indian word meaning "to

search”) Club was formed on 7 May 1955 and survived until April 1960. At full strength membership numbered nine (Brooks 1973).

Delmarva Ornithological Society.—In 1963 a group of DuPont Company research chemists and other interested birders formed the Delmarva Ornithological Society (DOS) (Brooks 1973, Wayne 1983); it currently meets at the Delaware Museum of Natural History and at the Delaware Nature Society’s Ashland Nature Center. Although named the Delmarva Ornithological Society, the organization’s main focus has been on Delaware. The first year of DOS’s existence ended with 126 members. In 2006 it had over 300 members. In addition to CBCs, the DOS conducts an annual (since 1969) spring count and year-round surveys of natural areas throughout the state, maintains a nest record card program, publishes the annual journal *Delmarva Ornithologist*, and lobbies on conservation issues. This interest in counting birds stems from its founder’s scientific background and a desire to see a quantitative basis for a description of Delaware’s avifauna (R. L. West, pers. comm., 30 November 2006). Publication of *Birds of Delaware* (Hess et al. 2000) has met this goal. In 1983, the Sussex Bird Club was formed by a group of 16 birders from Sussex County and sponsors two Delaware CBCs.

Delaware Audubon Society.—The Delaware Audubon Society (DAS) is a statewide chapter of the National Audubon Society. Incorporated in 1977, its mission is to develop a better appreciation of the natural environment and to work for species and habitat conservation. It also champions environmental issues and sponsors programs, field trips, and environmental education for schools. Its focus is on protection of the Delaware Bay and coastal region. The DAS is active in identifying Important Bird Areas (IBAs) in Delaware such as Delaware’s coastal zone (designated an IBA of Global Magnitude by the American Bird Conservancy), the White Clay Creek watershed, and the Pea Patch Island Heronry (Anonymous 2009). The DAS also sponsors DE-Birds, an e-mail discussion list about birding in Delaware (Anonymous 2009).

Bird studies at Delaware national wildlife refuges.—Established in 1937, Bombay Hook National Wildlife Refuge (NWR), located east of Dover in Kent County, comprises 6466 ha (15,978 acres).

Approximately 80% of the refuge is tidal salt marsh, making it one of the largest expanses of nearly unaltered tidal salt marsh in the mid-Atlantic region. The refuge also includes 445 ha (1100 acres) of impounded freshwater pools, brushy and timbered swamps and 445 ha (1100 acres) of agricultural lands, and timbered and grassy upland. The refuge and surrounding area is the site of the longest continuously run CBC in Delaware, beginning in 1939 and missing only 1944. Many of the state's "first" records of a species (e.g., Delaware's first breeding record of Black-necked Stilt, *Himantopus mexicanus*; Holgersen 1971) were made at Bombay Hook NWR.

Established in 1963, Prime Hook NWR, located north of Lewes in Sussex County, began as a satellite refuge to Bombay Hook NWR to the north and became an independent refuge in 2000. The refuge includes 4047 ha (10,000 acres) and one of the largest freshwater impoundments on the East Coast. Although the marshes are less accessible to birders than Bombay Hook NWR marshes, the Prime Hook marshes and surrounding lands provide interesting birding opportunities. The Cape Henlopen - Prime Hook CBC has been run continuously since 1964. University of Delaware researchers and students are conducting studies of saltmarsh birds focusing on saltmarsh sparrows (*Ammodramus* spp.), Coastal Plain Swamp Sparrow (*Melospiza georgiana nigrescens*) and Black Rail (*Laterallus jamaicensis*). Refuge staff members are conducting studies of marsh management impacts on waterfowl and shorebirds.

Delaware Division of Natural Resources and Environmental Control.—What was to become the Delaware Division of Natural Resources and Environmental Control (DNREC) began in 1911 when the Governor appointed the first Fish and Game Commissioners. Early efforts of the commission centered on hunting regulations, game species, and public education. The following excerpts from the report of the Game and Fish Commissioners for the period ending 31 December 1914 illustrate their concern:

"Many never consider that one of our most important duties is to protect the Birds. . . ., but because so few ever give a thought to the birds we cannot refrain from urging that the attention of all our people be called to the importance of more fully protecting our wild Birds, not only on account of their aesthetic value, and that is great indeed, but because of the vastness of their indispen-

sable service in maintaining the balance of life in nature between the insects, and vegetation. . . . The Board has inaugurated a campaign of education, through the Press of the State and State Wardens, concerning the importance of conserving all the wild life of the State, and hopes to enlist the Public Schools and Boy Scouts in the same work” (Webb and Higgins 2005).

Since its beginnings DNREC has grown into an agency that has ongoing monitoring programs involving Red Knot (*Calidris canutus*), Ruddy Turnstone (*Arenaria interpres*), Sanderling (*Calidris alba*), Dunlin (*Calidris alpina*), Piping Plover (*Charadrius melodus*), breeding terns, winter waterfowl, Bald Eagle (*Haliaeetus leucocephalus*), Osprey (*Pandion haliaetus*), forest birds, the Pea Patch Island heronry (in the Delaware River at the entrance to Delaware Bay, New Castle County), and avian influenza. Many of these programs are undertaken through the Non-game and Endangered Species Program established in 1983. Shorebird studies have been undertaken in partnership with the International Shorebird Survey; the British Trust for Ornithology; the New Jersey Division of Fish, Game, and Wildlife; the U.S. Fish and Wildlife Service; and other agencies and organizations. The Pea Patch Island heronry studies have been conducted with the Manomet Bird Observatory.

Bird studies at the University of Delaware.—Recent interest in birds at the University of Delaware, Newark, dates back to 1965, when F. H. Lesser (1965) wrote a thesis on impounded tidal marshes and waterbird prevalence at Little Creek Wildlife Area, immediately south of Bombay Hook NWR. Other thesis work has covered diverse topics such as work on bird diversity and abundance in urban woodlands (Burr 1968); habitat land cover changes in Milford Neck Conservation Area, Sussex County (Archer 2005); and West Nile virus in Fish Crow (*Corvus ossifragus*) roosting areas (Williams 2005). The first study of Wood Thrush (*Hylocichla mustelina*) at the University of Delaware woodlot looked at the species’ reproductive success (Longcore and Jones 1969). Since 1973 a banded population of Wood Thrushes has been studied by Roland R. Roth and his students (e.g., Johnson et al. 1990, Roth and Johnson 1993, Weinberg and Roth 1998). W. Gregory Shriver and his students are continuing the Wood Thrush studies. Current objectives of the study are to determine variation in Wood

Thrush mercury levels, evaluate the impacts of mercury on Wood Thrush reproductive success, and examine the candidacy of the Wood Thrush as a bioindicator of environmental mercury. Shriver is also conducting studies of saltmarsh birds at Prime Hook NWR to address issues associated with saltmarsh bird reproductive biology, habitat selection, mercury contamination, detection probabilities, and impacts of marsh management on breeding populations (e.g., Shriver et al. 2004).

THE DELAWARE MUSEUM OF NATURAL HISTORY

The Delaware Museum of Natural History, located north of Wilmington, was founded by John E. du Pont (Figure 1) and incorporated on 30 December 1957. The Museum (Figures 2 and 3) was constructed during 1969-1971 and opened its doors to the public on 13 May



Figure 1. John E. du Pont, ca. 1972. Photo from DMNH archives.



Figure 2. Delaware Museum of Natural History, entrance ca. 1972. Photo from DMNH archives.



Figure 3. Delaware Museum of Natural History, new entrance, July 2006. Photo from DMNH archives.

1972. At the time DMNH was said to be the first major North American museum to open since the Los Angeles County Museum of Natural History opened in 1910. DMNH is a nonprofit, free-standing private museum. The Museum and its programs are funded through an endowment, grants, and gate receipts.

John E. du Pont was born in 1938 and displayed an interest in natural history as a teenager. He attended the University of Pennsylvania in 1957 and graduated from the University of Miami in 1965. In 1957 he began collecting specimens for his museum, obtaining specimens that year from Pennsylvania, Delaware, Maryland, Georgia, and Texas. Those specimens are at DMNH. In 1958, with R. Tucker Abbott, a malacologist then at the Academy of Natural Sciences, Philadelphia, he organized his first expedition to the Philippines. This resulted in a collection of mollusks and about 400 bird skins, mostly from the islands of Luzon and Palawan. Expeditions in later years included additional Philippine islands. Expeditions to the South Pacific in 1975 and 1976 included New Caledonia and many islands in French Polynesia. A 1968 expedition to Australia focused on mollusks, but a few birds were collected. This work resulted in the publication of *Philippine Birds* (du Pont 1971) and *South Pacific Birds* (du Pont 1976).

In the early 1980s du Pont's interest turned to other pursuits and he ceased to have direct involvement with DMNH. In addition to his collections he was instrumental in securing some valuable items of property for the benefit of DMNH.

Most of the bird collection was amassed during the 1970s and 1980s through purchase, support of other institutions' expeditions, and DMNH expeditions, and John du Pont was actively involved in their acquisition. For example, in 1974, he flew to Oklahoma to personally take George Miksch Sutton's collection of study skins back to the DMNH (Jackson 2007:129). The collections in 2008 represented about 4000 bird species. The type collection contains 137 taxa. Major collections at DMNH, which will be discussed in more detail below, include all or parts of those of M. Hachisuka (1903-1953) and S. Dillon Ripley (1913-2001); George Miksch Sutton (1898-1982); Olin Sewall Pettingill (1907-2001); Thomas D. Burleigh (1895-1973); Dioscoro S. Rabor (1911-1996); Allan R. Phillips (1914-1996); and the combined collection of Harold H. Bailey (1878-1962) and John Eugene Law (1877-1931) [known as the Bailey-Law collection]. DMNH obtained specimens from the Charles G. Sibley (1917-1998) - Yale Peabody Museum's (YPM) worldwide collecting effort. The collection also houses specimens (skeletons and a few spread wings) from the *Exxon Valdez* accident. The egg collection contains the Donald J. (1892-1964) and Wray H. Nicholson collection (Florida; see Sprunt 1965), the

Vivian Hewitt (1888-1965; see Hywel 1973) collection (worldwide), and several local collections.

The Museum also has a collection of about 1000 mounted bird specimens that are used in museum exhibits and educational programs. A number of these specimens have scientific data, most notably a collection of birds with nests and eggs (nest dioramas) created by John D. Carter (1874-1947) and donated by the Westtown School, Chester County, Pennsylvania.

The geographic strengths of the bird collections are North America, the Philippines, and Mexico (Table 2). The Sutton and Phillips collections provide excellent representation of the American Southwest and Mexico. The Pettingill and Burleigh collections include many regions of the United States. The Hachisuka-Ripley and Rabor collections represent all of the major islands and many of the smaller islands of the Philippine archipelago.

Table 2. Geographic strengths of avian collections in the Delaware Museum of Natural History.

Geographic Region	% of collection
North America	37
Philippines	27
Mexico and Central America	22
Africa	5
South America	5
Indo-European and Asia	4
	100

From its beginning DMNH has experienced rapid growth. The Museum’s bird alcohol collections were ranked 8th largest in the world in 1982 (Wood et al. 1982). Since then this spirit collection has grown 78% and in 2009 it numbers over 6300 specimens. The avian skeletal collection was ranked 18th largest in the world in 1986 (Wood and Schnell 1986). This collection has since grown 79% and in 2009 numbers over 10,000 specimens; 15% of the skeletal specimens have an associated spread wing. The Museum’s egg collection, over 36,000 clutches, is the second largest in North America (Kiff and Hough 1985).

Several prominent ornithologists have served on the DMNH Board of Trustees. The list includes Dean Amadon (1971-1985), Kenneth C. Parkes (1976-1990), Robert S. Kennedy (1993-2000), and Storrs L. Olson (1999-2004). Kenneth C. Parkes of the Carnegie Museum of Natural History coincidentally was visiting John P. Hubbard (who was curator of the Bailey-Law collection at Virginia Polytechnic Institute and State University) when John du Pont was also visiting Hubbard. As with du Pont, Parkes was an expert on Philippine birds, and the two then began a relationship that would lead to a long-term friendship, scientific collaboration, and Parkes's tenure on the DMNH board of trustees. Parkes named a parrot, *Tanygnathus sumatranus duponti* Parkes (1971), in du Pont's honor.

Robert S. Kennedy has long had an interest in Philippine birds. This interest led him to contact du Pont in the early 1970s. The Museum provided some support for Kennedy's research in the Philippines but was unable to find funding for a position at DMNH for him. Kennedy's work on Philippine birds has drawn on the Museum's extensive Philippine bird collection. Eventually Kennedy served on the DMNH Board of Trustees.

ORNITHOLOGICAL STAFF AT THE DELAWARE MUSEUM OF NATURAL HISTORY

John P. Hubbard, curator of New World birds and mammals, 1971-1974.—John P. Hubbard served as curator of New World birds and mammals from 1971 to 1974. Hubbard arrived as an employee at the DMNH on 1 April 1971, having come from Virginia Polytechnic Institute and State University (VPISU). At VPISU he was the curator of the Bailey-Law natural history collection at Rockbridge Alum Springs near Lexington, Virginia (1 January 1969 to 31 March 1971). Du Pont hired him for the DMNH position. Hubbard first met du Pont while at VPISU, when du Pont visited the collection in search of rare and other birds for the DMNH collection, probably in the spring of 1970.

Hubbard's training as an ornithologist began as an undergraduate at Western New Mexico College (now University) in Silver City, New Mexico in 1958-1961. While there he collected and prepared bird and mammal specimens under the tutelage of Dale A. Zimmerman, a recent graduate of the University of Michigan. He then went to the University

of Michigan as a graduate student, where he was enrolled in 1961-1966 and worked toward a doctoral degree in zoology (ornithology) under Robert W. Storer. While there, he continued collecting and preparing bird specimens, including on expeditions to Mexico in 1963 and 1965, the southwestern U.S. in 1963 and 1964, and British Columbia and Alberta in 1965. He also spent a great deal of time in the University of Michigan Museum of Zoology bird collection, where he learned first-hand about curatorial practices, avian taxonomy, and various aspects of ornithological research. In 1967 he completed his dissertation, "A Systematic Study of the *Dendroica coronata* Complex," for a Ph.D. from the University of Michigan. Hubbard also worked at the Smithsonian Institution under George E. Watson as the field head of the Palearctic Migratory Survey, a contract program to study bird migration and avian arboviruses in Egypt and later in Cyprus and Uganda. He remained in that position until the end of 1968, when he went to VPISU.

When Hubbard arrived at the DMNH, he had considerable experience with bird and mammal collections, as well as having done field and laboratory research on birds and to a lesser extent mammals, herptiles, fishes, butterflies, mollusks, and plants. Between 1963 and 1970, he published 37 papers on biological topics, with most concerning birds. At his arrival, the collection and research facilities at DMNH were newly completed, while the exhibits were under construction. Du Pont gave him full authority over the curation of New World birds and mammals. He also did much of the curatorial work on Old World birds and mammals, which were primarily made up of specimens obtained by du Pont from Dioscoro Rabor and his collectors in the Philippines.

The Bailey-Law collection was formed by J. Eugene Law and for decades after his death in 1931 was housed at University of California Museum of Vertebrate Zoology in Berkeley. Law's widow, Laura, married H. H. Bailey and exercised her right to retrieve the collection, which was done once Bailey established his collection in the early 1960s at Virginia Polytechnic and State University (Hubbard 1969). Hubbard transferred some of the more valuable specimens to other collections, including the types for H. H. Bailey's bird and mammal taxa to the Smithsonian Institution and many pre-DDT era eagle eggs to the Western Foundation for Vertebrate Zoology. Hubbard oversaw the exchange of some specimens from the Bailey-Law collection to DMNH (pers. comm. Sept. 2001).

While at DMNH Hubbard continued his research on birds of the southwestern U.S. and adjacent Mexico. Ornithological expeditions to New Mexico were conducted under DMNH auspices in the summers of 1971, 1972, and 1973. Hubbard continued to deposit New Mexico specimens at DMNH after his return to New Mexico in 1974. Through Hubbard DMNH also contracted with Richard S. Crossin on another very fruitful expedition to northern Mexico in 1972-1973. Hubbard sent C. Gregory Schmitt on a mammal/bird expedition to Paraguay in 1972.

Hubbard also worked with du Pont on Philippine research, including writing publications on the subspecies of Ruddy Kingfisher (*Halcyon coromanda*) and Philippine night-herons in *Nemouria*, DMNH's occasional publication (see Appendix 1 for a list of bird related numbers). Hubbard named a subspecies of Rufous-crowned Sparrow, *Aimophila ruficeps duponti* (Hubbard 1975) in du Pont's honor. The acquisition of the Phillips collection began during Hubbard's tenure.

David M. Niles, curator of eggs, 1972-1974; curator of birds, 1974-1988.—On Hubbard's recommendation du Pont hired David M. Niles in 1972. Hubbard knew Niles when he was studying Horned Larks (*Eremophila alpestris*) for a master's degree at the University of New Mexico in the 1960s. Niles collected and prepared many birds, and curated the ornithological collection at the Museum of Southwestern Biology at the University of New Mexico. At the University of Kansas, Niles continued his studies of geographic variation in Horned Larks under Richard Johnston and received a Ph.D. based on that work in 1972.

Niles's first task was to curate the egg collection, a large part of which came from the British Trust for Ornithology (BTO). The BTO rescued the collection of Vivian Hewitt, a rich eccentric who lived on the island of Anglesey and collected obsessively. BTO had rescued the collection just before it was to be destroyed. The BTO transferred one part of Hewitt's collection, the Jourdain Collection, to the British Museum (Natural History) (BM[NH]), and sold the remainder of the collection to DMNH. After Hubbard's departure in 1974, Niles assumed responsibility as curator of birds, and accompanied du Pont on the 1976 South Pacific Expedition. During his tenure the egg, skin, skeletal, and alcoholic specimen collections continued to grow. Collections arriving during this time include many of the Rabor, and M. Hachisuka - S. Dillon Ripley Philippine specimens, the G. M. Sutton, O. S. Pettingill,

T. D. Burleigh collections, and the Sibley-YPM specimens. Niles spent much of his time curating the multitude of specimens that were steadily arriving and published little.

The American Ornithologists' Union held its 94th Stated meeting at Haverford College, Haverford, Pennsylvania in August 1976. "The annual banquet was preceded by a reception hosted by the Delaware Museum of Natural History in Greenville, Delaware. The dramatic exhibits of birds and mollusks and the spacious study areas and library of the Museum were open during the reception" (Watson 1977). There was also a sponsored field trip to the not too distant Bombay Hook National Wildlife Refuge.

Gene K. Hess, curatorial assistant/collection manager, 1976-2007.—Gene K. Hess (Figure 4) joined the department in 1976 first as a student and later as curatorial assistant. He has a B.S. degree from the University of Delaware. Like Niles, his first job was working in the egg collection. From there he moved to cataloging, specimen preparation, working in the bug room, and other collection related tasks. Upon the



Figure 4. Gene K. Hess, May 2000. Photo from DMNH archives.

departure of Niles in 1988, Hess became collection manager and was acting department head until a curator was hired in 2001. In 1992 Hess started a project to preserve in alcohol series of local birds to complement DMNH's holdings of local birds preserved as skeletons. That project has resulted in a collection of about 2500 specimens representing about 130 species.

Work on the *Birds of Delaware* (Hess et al. 2000) began in 1983 with the undertaking of a Breeding Bird Atlas project. During the course of discussing how to publish the atlas, the publication committee realized that here was an opportunity to do a volume on the ornithology of the state – something that had never been done. Hess served on the Breeding Bird Atlas Publication Committee, Steering Committee, and was the Technical Committee chairman. He was also a regional coordinator for fieldwork.

Jean Woods, curator of birds, 2001-present.—Jean Woods (Figure 5) joined the DMNH staff as curator of birds in 2001. She is a graduate of the University of Michigan and studied under Robert B. Payne. Jean



Figure 5. Jean L. Woods, April 2002. Photo from DMNH archives.

Woods' research focuses on avian song, adding a new dimension to DMNH collections.

Recently (2007) Woods and Hess converted the bird collection storage to a compactor system. In 2007 Woods and Hess made collection data available over the Internet via the ORNIS project (see more about ORNIS at Anonymous 2004). Plans also include creation of a dedicated fluid specimen workroom and storage space.

The Delmarva Ornithological Society and other outreach efforts of the DMNH.—From its earliest years, the DMNH Bird Department has reached out to the local birding community. The Delmarva Ornithological Society (DOS) formerly held its monthly meetings at DMNH for many years and still meets there several times a year. A regional birding telephone hotline, *Birdline Delaware*, sponsored by an anonymous donor, is housed in the DMNH Bird Department. The DOS, under the guidance of John Hubbard, began a nest-record card program that remains active. Hubbard served as editor for the Society's journal, *Delmarva Ornithologist* in 1974; he also contributed a number of articles to the journal. Hess has served as editor for the *Delmarva Ornithologist* (1993 to present) and has also contributed articles to the journal. He served DOS as field-trip chairman (1982-1985), on Council (1984-1987), and on the Delaware Records Committee (1982-1996). In recognition of DMNH staff contributions to DOS the society elected Hubbard an honorary member and Hess a fellow and honorary member of the society.

An important part of the Bird Department's outreach program is working closely with Tri-State Bird Rescue and Research (internationally recognized for its success in rehabilitating oiled wildlife) since its inception in 1977. DMNH curator David M. Niles became involved with TSBR shortly after its establishment. As a result of that close cooperation, DMNH continues to obtain significant series of regional birds.

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LITERATURE CITED

- Anonymous. 2004. ORNIS. Accessed 11 July 2009 at: <http://olla.berkeley.edu/ornisnet/>
- Anonymous. 2009. Delaware Audubon. Accessed online, 30 April 2009 at: www.delawareaudubon.org.
- Archer, E. D. 2005. Avian habitat related land cover changes in the Milford Neck Wildlife Conservation Area. M.S. thesis, University of Delaware, Newark.
- Brooks, S. T. 1973. Formation of the Delmarva Ornithological Society. *Delmarva Ornithologist* 8:45-47.
- Buckalew, H. 1933. American Egret nesting in Delaware. *Auk* 50:206.
- Buckalew, H. 1934. Nesting of Boat-tailed Grackle and Blue-winged Teal in Delaware. *Auk* 51:385.
- Burr, R. M. 1968. Bird diversity and abundance in urban woodlands of northern Delaware, 1966-1968. M.S. thesis, University of Delaware, Newark.
- Bush, W. D. 1878-1881. Diary of birdwatching. Bound with Delaware State Poultry Society Records, 1870-81. Manuscript 45:30 Societies D in the collection of the Historical Society of Delaware, Wilmington, Delaware. Typescript of the diary was donated to T. S. Palmer, in care of the Department of Agriculture, Biological Survey, Washington, D.C. on 5 April 1905 by K. Danforth Bush, and is filed with the Lighthouse Section of Biological Survey papers at Patuxent Wildlife Research Center, Laurel, Maryland.
- Cantwell, R. 1961. Alexander Wilson, naturalist and pioneer. J.B. Lippincott Company, Philadelphia, Pennsylvania and New York.
- du Pont, J. E. 1971. Philippine birds. Monograph Series 2. Delaware Museum of Natural History, Greenville.
- du Pont, J. E. 1976. South Pacific birds. Monograph Series 3. Delaware Museum of Natural History, Greenville.
- Hess, G. K., R. L. West, M. V. Barnhill III, and L. M. Fleming. 2000. Birds of Delaware. University of Pittsburgh Press, Pittsburgh, Pennsylvania.
- Hesselius, A. 1947. Journal of Andreas Hesselius, 1711-1724. Translated by Amandus Johnson. *Delaware History* 2:69-118.
- Holgersen, N. E. 1971. Black-necked Stilt nesting in Delaware. *Wilson Bulletin* 83:100.
- Holm, C. T. 1834. A short description of the province of New Sweden. Translated by P. Du Ponceau. *Memoirs of the Historical Society of Pennsylvania*, Vol. 3, Philadelphia, Pennsylvania.
- Hubbard, J. P. 1969. The Bailey-Law collections. *Atlantic Naturalist* 24:201-203.
- Hubbard, J. P. 1975. Geographic variation in non-California populations of the Rufous-crowned Sparrow. *Nemouria* 15:14.
- Hywel, W. 1973. Modest millionaire: the biography of Captain Vivian Hewitt. Gwasg Gee, Denbigh, North Wales, United Kingdom.
- Inskip, G. A. 2000. Pp. 21-25, in G. K. Hess, R. L. West, M. V. Barnhill III, and L. M. Fleming, Birds of Delaware. University of Pittsburgh Press, Pittsburgh, Pennsylvania.
- Jackson, J. A. 2007. George Miksch Sutton: artist, scientist, and teacher.

University of Oklahoma Press, Norman.

- Jameson, J. F. 1909. *Narratives of New Netherland, 1609-1664*. Charles Scribner's Sons, New York.
- Johnson, R. K., R. R. Roth, J. T. Paul, Jr. 1990. Mass variation in breeding Wood Thrushes. *Condor* 92:89-96.
- Jones, F. M. 1950. Reminiscences of a Delaware naturalist. *Delaware Notes* 23:13-35.
- Kalm, P. (1753-1761) 1937. *Peter Kalm's travels in North America* (A. B. Benson, ed.). 2 Volumes. Wilson-Erickson, New York.
- Kiff, L. F., and D. J. Hough. 1985. Inventory of bird egg collections of North America, 1985. American Ornithologists' Union and Oklahoma Biological Survey, Norman, Oklahoma.
- Lesser, F. H. 1965. Some environmental considerations of impounded tidal marshes on mosquito and waterbird prevalence, Little Creek Wildlife Area, Delaware. Master's thesis, University of Delaware, Newark.
- Lindstrom, P. 1925. *Geographia Americae* (with an account of the Delaware Indians). Translated and edited by Amandus Johnson. Swedish Colonial Society, Philadelphia, Pennsylvania.
- Longcore, J. R., and R. E. Jones. 1969. Reproductive success of the Wood Thrush in a Delaware woodlot. *Wilson Bulletin* 81:396-406.
- McDowell, M. 1989. Cypress, sea rockets, and Nuttall's trip to Delaware. *Delaware Conservationist* 32(3):4-7.
- Myers, A. C. 1912. *Narratives of early Pennsylvania, west New Jersey and Delaware 1630-1707*. Charles Scribner's Sons, New York. (Reprinted by Barnes & Noble 1959).
- Nuttall, T. 1832-1834. *A manual of the ornithology of the United States and Canada*. Vols. 1 and 2. Hilliard and Brown, Cambridge, Massachusetts.
- Palmer, T. S., and others. 1954. *Biographies of members of the American Ornithologists' Union*. American Ornithologists' Union, Washington, D.C.
- Parkes, K. C. 1971. Two new parrots from the Philippines. *Bulletin of the British Ornithological Club* 91:97.
- Rhoades, S. N., and C. J. Pennock. 1905. Birds of Delaware: a preliminary list. *Auk* 22:194-205.
- Roth, R. R., and R. K. Johnson. 1993. Long-term dynamics of a Wood Thrush population breeding in a forest fragment. *Auk* 110:37-48.
- Shriver, W. G., T. P. Hodgman, J. P. Gibbs, and P. D. Vickery. 2004. Landscape context influences salt marsh bird diversity and area requirements in New England. *Biological Conservation* 119:545-553.
- Sprunt, A., Jr. 1965. Donald John Nicholson [obituary]. *Auk* 82:324-325.
- Turnbull, W. P. 1869. *Birds of East Pennsylvania and New Jersey*. Privately printed, Glasgow, Scotland.
- Watson, G. E. 1977. Proceedings of the ninety-fourth stated meeting of the American Ornithologists' Union. *Auk* 94:123-139.
- Wayne, W. J. 1983. The Delmarva Ornithological Society's first twenty years. *Delmarva Ornithologist* 16:3-6.
- Webb, D. L., and T. L. Higgins. 2005. Preserving Delaware's natural history: the first century. Unpublished report. Delaware Division of Fish and Wildlife, Department of Natural Resources and Environmental Control,

Dover, Delaware.

- Weinberg, H. J., and R. R. Roth. 1998. Forest area and habitat quality for nesting Wood Thrushes. *Auk* 115:879-889.
- Williams, G. M. 2005. West Nile virus activity in roosting areas of the Fish Crow (*Corvus ossifragus*). Ph.D. thesis, University of Delaware, Newark.
- Wilson, A., and C. L. Bonaparte. 1859-1860. American ornithology. Willis P. Hazard edition, Porter and Coates, Philadelphia, Pennsylvania.
- Wood, D. S., and G. D. Schnell. 1986. Revised world inventory of avian skeletal specimens, 1986. American Ornithologists' Union and Oklahoma Biological Survey, Norman, Oklahoma.
- Wood, D. S., R. L. Zusi, and M. A. Jenkinson. 1982. World inventory of avian spirit specimens, 1982. American Ornithologists' Union and Oklahoma Biological Survey, Norman, Oklahoma.

History of Manomet Bird Observatory

Kathleen S. Anderson¹

ABSTRACT. The Manomet Bird Observatory, now the Manomet Center for Conservation Sciences (MCCS), was founded in 1969 on a prominent point known for its diversity of migrant birds near the village of Manomet, Massachusetts. The goals of the founders were to provide a site and opportunity for long-term studies of birds and other aspects of the natural history and ecology of southeastern Massachusetts. Activities at Manomet have extended far beyond birds and Massachusetts. Research projects have taken staff from the Arctic to Tierra del Fuego, from tropical forests of Central America to boreal forests of northern New England and Canada, from the ocean to the uplands, and from studies of pesticide pollution to measuring absorption of radiation in wild birds. Former interns at Manomet have gone on to distinguished careers in education, medicine, conservation, and government. The early history of Manomet Bird Observatory (1969-1983) relies heavily on the recollections of the author. The more recent history relies on information supplied by people doing research at the Observatory (Center). The Bibliography lists published documents that represent the corpus of research done at MBO and MCCS.

GENESIS

Several seemingly unrelated events during the mid-1960s led to establishment of the Manomet Bird Observatory in August, 1969. Chandler S. Robbins of the U.S. Fish and Wildlife Service, Aaron Bagg, James Baird, and others with interests in bird migration and bird banding had created a network of bird banders operating volunteer-staffed banding stations along the Atlantic coast at sites of known bird concentrations ("migrant traps") during fall migration. Known as "Operation Recovery" or "OR," hundreds of people participated, thousands of birds were banded, and the results changed many previously held concepts of which, when, and why migrants concentrate along the Atlantic coast during the fall (Baird et al. 1955).

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Kathleen Anderson had been banding and sampling blood of birds in southeastern Massachusetts as the ornithologist for the Encephalitis Field Station (EFS) (Anderson 1961, Anderson and Maxfield 1962, Hayes et al. 1962). Originally established by the U.S. Public Health Service in 1957 to research the role of birds in the ecology of eastern equine encephalitis (EEE) and other arthropod-borne viruses in southeastern Massachusetts, the station had been turned over to the Massachusetts Department of Public Health in 1963. In 1964 in an effort to determine if the EEE virus was being introduced into Massachusetts by birds migrating into the area from the Maritime Provinces and northern New England, Anderson enlisted local birders and experienced banders to join her in a two-year project at a thicket on Duxbury Beach, just north of Plymouth, Massachusetts, that was known to attract large numbers of migrant birds during autumn.

Volunteers checked nets and banded birds while Anderson collected blood samples only from immatures of suspected northern origin. The banding records became part of the OR data base. It was suspected that coastal migrants flew directly from the Maritime Provinces, and hence, if blood from immature birds tested positive for either virus or antibodies, they probably brought the virus with them from well north of Massachusetts. Operation Recovery ultimately proved this hypothesis false (Anderson 1965, Anderson et al. 1967).

As the Duxbury Beach project wound down in October 1965, enthusiastic participants asked how they might continue this project the following year. Among them were John and Rosalie Fiske, newly retired to Massachusetts from New York City (Figure 1). They had visited the Fair Isle Bird Observatory the previous year and, coincidentally, Anderson had visited the newly-established Point Reyes Bird Observatory, where she had been impressed by the banding operation, the seabird research on the Farallon Islands, and the number of volunteers who assisted the small staff.

The demands of Anderson's work at the Encephalitis Field Station and the lack of an appropriate location for fall banding made a future OR endeavor unlikely until Rosalie Fiske (Figure 2) suggested that a summer home belonging to her cousin, Roger Ernst, situated on a high bluff at Manomet and surrounded by an extensive thicket of brush and pines, might be available at no cost. Known as "Widewater," the site was familiar to a few birders who occasionally trespassed during the fall



Figure 1. Rosalie and John Fiske in the 1940s.



Figure 2. Rosalie Cheney Fiske.

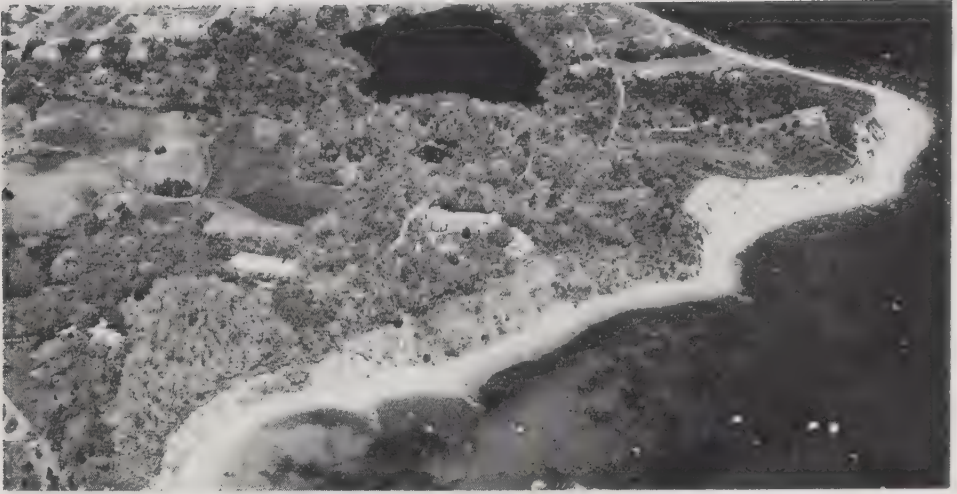


Figure 3. View of old "Widewater" building on bluff's edge, with the new building just beyond it. Manomet Point is on the far right.

when the house was closed and the thickets teamed with migrant birds (Figure 3). Thanks to Rosalie Fiske's powers of persuasion, Roger Ernst's widow permitted a rotating group of volunteers under Anderson's direction to move into the large Victorian summer house in August 1966, to set up nets along the maze of trails which rambled over 7.5 ha (18.5 acres) and band birds for the Operation Recovery Program. Anderson divided her time between encephalitis work and the Manomet OR station.

Each autumn, 1966-1968, from early August through the end of October, the number of volunteers grew, the local coterie joined by experienced banders from all over the Northeast. Local teachers asked to bring their classes to see birds in the hand (Figure 4). A few college students heard of the operation and appeared, asking if they might stay over while learning to band birds. Neighbors turned up to find out what was going on at Widewater and returned bringing friends. Bird clubs and others with an interest in birds heard about the banding and showed up (Figure 5). As eiders and scoters began passing on stormy days, some volunteers went to nearby Manomet Point to tally the skeins of waterfowl and this became known as the "Seawatch."

The Fiskes, Anderson, and others began to talk of the possibility of a permanent research station. John and Rosalie went to Mrs. Ernst, who



Figure 4. Kathleen S. Anderson and school children at Manomet for a banding demonstration, 1969.

had seldom visited Widewater after her husband's death, and proposed that she donate the property for a bird observatory. Legal papers were drawn, the incipient observatory was incorporated as a non-profit organization, and John Fiske used New York and Boston contacts to raise the initial funding needed for incorporation, minimal operating expenses, and one small salary (Figure 6). Anderson left the Encephalitis Field Station to become the Director and only salaried employee. With the legalities in order, a board of directors, one full-time employee and a core group of volunteers, the newly formed Manomet Bird Observatory opened its doors on the first Monday in August 1969, just in time for the very first fall migrants to appear in the nets. For many years those who were there that August 4th returned on the week-



Figure 5. Kathleen Anderson with a group from Pleasant Valley Audubon Sanctuary in the Berkshires of western Massachusetts. At left is Alvah Sanborn the Sanctuary Director.

end nearest the fourth for birthday celebrations that participants still remember with nostalgia.

THE EARLY YEARS: 1969-1983

Manomet Bird Observatory had come about at a propitious time. There was a growing awareness, locally and nationally, of serious environmental problems. Membership in conservation organizations was expanding and the first Earth Day, 21 March 1970, occurred only seven months after MBO came into being.

The first two years were a fast-paced blend of full-time banding, constant visitation (planned and unplanned), a busy education program, and growing recognition that a scientific staff would be needed if the observatory were to expand research beyond banding. In July 1972, Brian A. Harrington completed his M.S. at Florida State University and

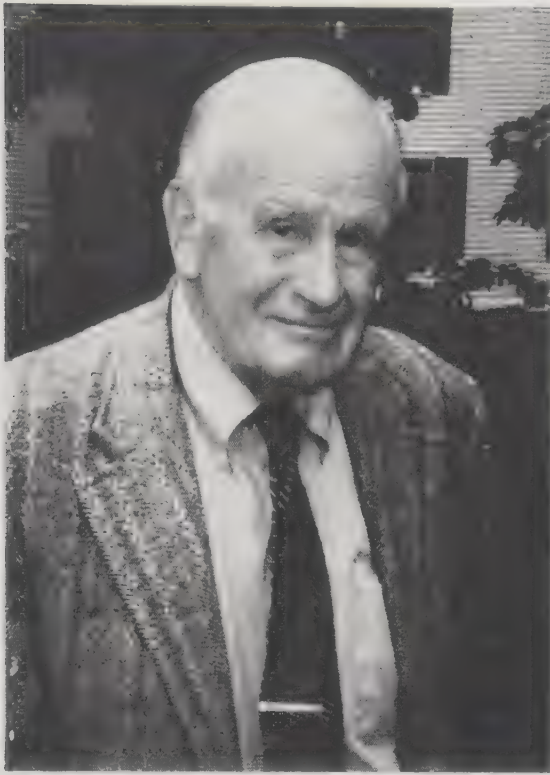


Figure 6. John Fiske, ca. 1985.

returned to his native New England to become the first full-time MBO biologist. He was joined a month later by Trevor L. Lloyd-Evans, who came from England with extensive banding experience at British observatories and at the British Trust for Ornithology.

Not long after Manomet opened, Joseph A. Hagar, having heard of the scoter counts, appeared on the bluff to find out what this field station, so near his Marshfield home, was all about (Figure 7). The retired state ornithologist (Anderson 1990a, 1991), well known for his studies of the Hudsonian Godwit (*Limosa haemastica*; Hagar 1954, 1966) and the American Black Duck (*Anas rubripes*; Hagar 1976), was soon sharing his knowledge of sea ducks with Wayne Petersen, an enthusiastic volunteer who was then heading up the Manomet Seawatch. When Harrington joined the staff, Hagar saw an opportunity to expand Harrington's experience with seabirds to include research on shorebirds,



Figure 7. Kathleen S. Anderson, Joseph A. Hagar, and Oliver L. Austin, Jr. (right) on the bluff at Manomet overlooking Cape Cod Bay, ca. 1975.

Hagar's own favorite avian group and one whose biology he felt was not, at that time, receiving the attention warranted by their extraordinary migrations and complex life styles. Kathleen Anderson and Joseph Hagar were both dedicated to the premise that only careful research over long periods of time could produce adequate understanding of the impacts of environmental changes occurring worldwide. Anderson was fond of saying: " 'Everybody' says 'somebody' should be doing long-term research to find out what is happening. This is what MBO does" (Anderson 1977).

A combination of Hagar's growing interest and involvement in the research projects, and the fact that he was retired and lived not far away, led to an invitation to become Manomet's Managing Trustee with more day-to-day involvement in business aspects as well as with research. He became a mentor to Anderson and to many of the staff and volunteers.

Nothing of MBO's growing reputation for excellence would have been possible without the loyal, hard-working volunteers. As

Anderson's only staff for the first year or two, volunteers set nets, banded birds, kept records, guided visitors, took birds to school classrooms, managed membership and finances, organized the library professionally, produced the newsletters and became totally indispensable (Anderson 1979). Most volunteers lived in the area and came to MBO early each morning. A few came from great distances and moved into Widewater for days at a time, providing protection for both nets and building.

Two volunteers arrived when they were most needed and these women were particularly essential during the times they lived at "Widewater." Erma J. "Jonnie" Fisk (Anderson 1990b) arrived from her summer home on Cape Cod soon after MBO opened in August of 1969. An experienced bander, she stayed at Widewater for days at a time, supervising less accomplished banders during the day when Anderson was otherwise occupied, and keeping an eye on the house and its younger occupants when the nets were closed. She often made generous financial gifts when the budget was in crisis.

In 1970 Helen Passano found a place that needed her and for several years had an important role at Manomet. Although not a bander, she had both a sense of humor and a sense of order, badly needed in a rambling old house soon overflowing with high-energy college students. With Jonnie or Helen in residence, it was possible for Anderson to go home at night knowing a responsible adult was "keeping the lid on" potential chaos.

Other volunteers brought unique talents to Manomet. Gilbert Fernandez and his wife Josephine were among the first banders to respond to the call for volunteers in 1966 when Widewater became an OR station. Gil worked on Ospreys (*Pandion haliaetus*) along the Westport River in southeastern Massachusetts, aiding their recovery by erecting nest platforms and bringing healthy eggs from Chesapeake Bay Ospreys to put under Massachusetts birds that were laying thin-shelled eggs due to DDT. He was already well known (Spitzer and Poole 1980). A skilled photographer and former English teacher, Gil became editor of MBO's first newsletters; these were important in maintaining a supportive membership.

The sprawling summer house which served as both headquarters and residence was gradually winterized and remodeled. Eventually the gift of additional land a few miles north along the coast with another

summer house provided more staff housing. In 1991 the adjacent Holmes farm was acquired, the 8.1 ha (20 acres) of field, bog, and woods, thus increased area at Manomet's headquarters to about 16.2 ha (40 acres). The acquisition included an 1840 farmhouse that was available for staff housing.

John Fiske, Ruth Ernst, and Ruth's lawyer, James Ames, were the original Trustees at MBO. A larger Board was created, including a combination of involved local people and representatives of the Boston business community with interests in birds and/or conservation. An Advisory Committee of well-known scientists was established. Among them were James Baird, Roland C. Clement, Mary H. Clench, William H. Drury, Douglas A. Lancaster, Constantine Maletskos, Wesley E. Lanyon, Ernst Mayr, and Chandler S. Robbins.

As MBO expanded research into new areas and became better known, more opportunities appeared for contract research. The staff grew. Ornithologists, government bureaucrats involved with contracts, researchers, and professors from colleges and universities here and abroad, came by on business, out of curiosity, or for other reasons, making MBO a stimulating place for staff and interns. Manomet Bird Observatory during its first 15 years was a yeasty place, full of energy, excitement, perceived or imagined opportunities, and a growing reputation. But for those responsible for the bank account, there was the continual worry about "cash flow." Membership was growing, but money was always in short supply.

MBO's influence was felt far beyond its somewhat isolated location in southeastern Massachusetts on a bluff overlooking Cape Cod Bay. Staff presented papers at scientific meetings across the continent and served on boards, councils, and committees of ornithological and conservation organizations locally and afar. The Northeastern Bird-Banding Association (NEBBA) held occasional meetings and field trips at Manomet. The structure and meetings of the Nuttall Ornithological Club (NOC; based at Harvard University) were increasingly influenced by MBO (Davis 1987). In 1974 Anderson and Harrington became members of the NOC, soon followed by Lloyd-Evans. Lloyd-Evans and Anderson served terms as president, Anderson being the first woman ever to serve as president of this very "Old Guard" organization. Most new NOC members during the 1980s had some training or connection with MBO. William Davis, Paul Donahue, John Kricher, and Wayne Petersen were among those with long close associations with MBO.

Manomet used the Club meetings, and its excellent speakers, as an educational adjunct for its intern program.

When the American Ornithologists' Union held its 101st anniversary meeting in New York City in 1983, an MBO staff member went down the list of attendees and discovered that one out of every eight attendees had some connection to Manomet – as intern or staff (past or present), or as a visiting scientist, guest lecturer, casual visitor, or professor bringing a class or visiting a student. Whatever had brought them to MBO, this was quite an extraordinary record for such a young organization.

EDUCATION AT THE MANOMET BIRD OBSERVATORY

There was an educational component to activities at Manomet from the very first days as an Operation Recovery Station. Neighborhood children appeared, turning up on the porch where the first banding station was set up or discovered slipping along the trails where the nets were set. Manomet OR attracted a diversity of visitors. As word spread that children were welcome, teachers and scout leaders asked if they might bring groups “to see the wild birds” and Anderson and other volunteers conducted impromptu banding demonstrations for youngsters as well as for garden clubs and other adult groups.

Once officially opened as a permanent field station, requests mushroomed and formal visits were scheduled. In 1970, the first full year, there were visits by groups from five colleges, numerous elementary and secondary schools and summer camps (including about 1500 children), garden clubs, nursing homes, bird clubs, and conservation groups. Gil Fernandez, who was fluent in Spanish, demonstrated banding using Spanish when he spoke to a high school Spanish class. Seventeen college and post-college students moved in for varying periods and eventually came to be called “interns.” By 1971, field trips for schools and colleges were fully booked for every weekday and some weekends and many schools were turned away. Adult classes were offered afternoons or evenings on bird identification for beginners, bird biology, and preparation of bird skins as scientific specimens. There were workshops on leading field trips, and training sessions for volunteers on banding, netting, trapping, and record-keeping. An off-site program on waterfowl identification was given for hunters and birders.

As demands grew, volunteers developed a "Birds-Go-to-School" program that in 1971 reached about 1900 children; program requests came from as far away as Rhode Island. With cooperation of the School Volunteers for Boston, MBO expanded into Boston schools. Lectures by Anderson and volunteers reached about 2500 adults, in addition to the listeners to two radio shows and viewers of a television program. MBO and the Plymouth Conservation Committee co-sponsored a Conservation Night. By the end of 1971 it was calculated that more than 8000 adults and children had been reached by one or another of the MBO educational programs, all by one full-time employee and a staff of energetic volunteers. The demand was overwhelming, exhausting, and had outgrown the availability of volunteers as well as time and space.

There seemed to be no limit to the popularity of the outreach programs. With the addition of the first scientific staff in 1972 and an expanding research program, priorities had to be set. With its constraints of size and budget, MBO could not be all things to all people. Education programs were gradually down-sized, although school classes continued to visit MBO and volunteers visited both local and Boston schools. At the same time the intern program grew rapidly as potential interns and their biology professors realized the depth of experience to be gained at MBO.

THE MANOMET INTERN PROGRAM

Manomet did not consciously plan an intern program. Young people, mostly high school students, had been on the scene during the Operation Recovery years. However, soon after MBO officially opened in 1969, college students appeared, wanting to learn to band and to participate in other activities. Kimberly Smith, an undergraduate at Tufts University who later became a professor at the University of Arkansas and Editor of *The Auk*, was the first to move into the old house and become an integral part of all the activities: banding, guiding visitors, demonstrating how to handle and band birds and helping out wherever needed.

Smith was only the first of at least 210 interns who lived and worked at Manomet between 1969 and 1983, many of whom are now well-known ornithologists, ecologists, artists, writers, and/or conserva-

tionists. (See Appendix 1 for a list of interns at Manomet during these years.) Their high spirits, youthful energy, and good humor helped create MBO's congenial and "family" atmosphere that staff and visitors recall with nostalgia.

There were no narrowly defined parameters for an MBO internship. There was no fee, but interns were responsible for their own food and living expenses. Minimal living expenses were sometimes provided for those who could not otherwise have participated. The second floor bedrooms served as crowded dormitories. The expectation was that all interns would lend a hand wherever needed, including but not limited to, running net lanes, banding birds, demonstrating banding to visitors and school groups, doing dishes, mowing lawns, leaving at midnight when the tide was high to net shorebirds on Plymouth Beach, conducting breeding bird surveys on the Myles Standish State Forest at dawn, recording migrating sea ducks at Manomet Point, going out to sea as observers on commercial fishing boats or research vessels from the Woods Hole Oceanographic Institution—wherever staff needed help the interns were on call.

In exchange for this volunteer help, the crowded dormitories were free and the diversity of practical experience in field biology was exceptional for students contemplating careers in any field of biology. The one-on-one relationships with the staff, volunteers, and with the many scientists, professors, and government biologists who visited, shared the kitchen table at lunch time, and presented informal seminars on their work, made Manomet an unforgettable learning experience.

There were no advertisements or announcements of the availability of this experience, but interns arrived from all over North America, South America, and Europe. Without them the small staff could not have accomplished so much in so few years. Anderson and others still hear from former interns who credit this experience with being one of the most important parts of their education.

After leaving MBO, former staff member David Schneider wrote Anderson (28 February 1983):

"I would vote for the intern program as far more important than anything I contributed. Manomet was far ahead of its time. One has only to look at the exponential increase in the number of conservation internships, such as those advertised all the time on the Cornell website. Any history of Manomet

should include a listing of interns, and perhaps a few statements of the impacts of those experiences.”

Sarah Groves, who went on to obtain her doctorate at the University of British Columbia (UBC), wrote (21 March 2005):

“As for my experience at MBO, it is hard to believe that it has been several decades because in many ways the experience and my impressions of it still seem so fresh that it could have been last year! For me, the opportunity to work at MBO while still an undergraduate really helped to shape the course of my undergrad studies. Working on shorebirds at MBO while I was still an undergrad . . . was a wonderful experience in every respect. It was probably the strongest influence on my decision to go to graduate school . . . When I got to UBC I found that I knew as much or more about birds (of many species) and banding them than just about anybody else in the department. The caliber and dedication of the people who guided the research and projects at MBO – Archie Hagar, Brian Harrington, Trevor Lloyd-Evans, and Kathleen Anderson – have been a lasting inspiration to me. It was also tremendously energizing to work some place that was dedicated to research and education without being caught up in the university system and shorter-term research efforts that are tied to the publish-or-perish/tenure system. Now that it’s quite apparent that lots of things are broken on this planet, the value of data collected on a sustained, long-term basis is increasingly obvious. Perhaps the most valuable part of my experience at MBO was the opportunity to be immersed in a specific project and to begin to understand the project from many different angles through field work, data analysis, and talking with colleagues. I don’t think that many of my contemporaries had similar field experiences until graduate school (or maybe never). Now as computers become surrogates for “the real world” in many aspects of undergraduate education, and as the general population becomes ever more urban, I think that many university graduates and post-grads have had remarkably little (or no) field experience to inform their understanding of ecology and the natural world around them. I always thought that the MBO intern program played an important and

unique role in training field ecologists with a view toward the long term, and I was surprised and very disappointed when I heard that the program had been eliminated . . . ”

The concept of Manomet interns as volunteer staff immersed in all the observatory's activities ended with Anderson's departure at the end of 1983. It was replaced by the income-producing Field Biology Training Program (FBTP) which virtually eliminated opportunities formerly available to those without financial resources. College students received a semester's credit for participation in a prescribed program of lectures and field work with staff for a specified period. Students became a more homogenous group by age, background, and academic level. With the changes came some loss of the diversity and spontaneous energy created by the previous unstructured and eclectic mix of traditional and nontraditional students of widespread ages and cultural backgrounds (Figure 8).

OPERATION SEAWATCH

Although it was the banding of passerines that initially led to the founding of the Manomet Bird Observatory, in 1969 MBO began a four-year study of sea duck migration at Manomet Point. The program was directed by Wayne Petersen with the active advice, support, and encouragement of Joseph A. Hagar. Hagar had initiated counts of scoters passing the point in 1939 and 1940 while employed as State Ornithologist by the Commonwealth of Massachusetts. Hagar's records proved very useful as a comparative data set. Petersen, at that time an undergraduate at the University of Massachusetts, Boston, credits Hagar with having a profound influence on his future thinking about birds, especially waterfowl, rails, and shorebirds. Over the four seasons that the waterfowl passage was documented most intensively, Petersen enlisted and coordinated a volunteer corps of observers, some of them formerly experienced waterfowl gunners. They maintained almost daily "seawatches" at Manomet Point, a traditional location for "coot shooting." Manomet Point was an ideal location for these observations because of the concentrations of seafoal passing close to the point as they flew south into Cape Cod Bay.



Figure 8. Reunion of MBO interns, 1990.

In 1972 the study was expanded to include Sandy Neck in Barnstable, First Encounter Beach in Eastham, and Race Point in Provincetown. Changes documented in the study indicated, for example, that the Surf Scoter (*Melanitta perspicilla*) had supplanted the White-winged Scoter (*M. fusca*) as the commonest of the three scoter species entering Cape Cod Bay (Petersen 1971, 1973, 1983).

A preliminary study of the spring migration of Brant (*Branta bernicla*) in nearby Duxbury Bay by intern Scott Sutcliffe in 1971 was followed by additional field work which led to a Master's thesis by intern Thomas Clough (Clough 1977).

The Manomet Point Seawatch gradually lost its attraction as the cadre of volunteers drifted toward other programs or pursued other interests, and seawatches became only occasional events, usually on stormy days when skeins of thousands of scoters and eiders passed closer to the exposed point.

IBIS AND HERON RESEARCH

The first documented breeding of Glossy Ibis (*Plegadis falcinellus*) in Massachusetts was recorded on Clark's Island in Plymouth Harbor in 1974 by Wayne Petersen, Anderson, and Harrington of the MBO Staff. Studies of the large heronry on Clark's Island were initiated by Harrington in 1975 (Harrington 1975), later expanded upon by Katherine Caldwell Parsons (Figure 9), Robert Bertin (Bertin 1975), and other MBO interns. William E. Davis, Jr. of Boston University continued the work at Clark's Island until the early 1990s (Davis 1986, 1990; Davis et al. 1979, Davis and Parsons 1982, 1991; Parsons 1981, 1982).

Parsons obtained her Ph.D. at Rutgers University in 1985 and she and her associates have been working on Atlantic Coast heron colonies since then with a particular interest in wetland use and contaminant impacts (Burger et al. 1992; Czech and Parsons 2002; Golden et al. 2003; Matz and Parsons 2004; Parsons 1981, 1982, 1994, 1996, 2002, 2003; Parsons and Burger 1982; Parsons and Chao 1983; Parsons and Master 2000; Parsons and McColpin 1995; Parsons et al. 1991, 2000, 2001; Rattner et al. 2000).

In 1974 Manomet received a contract from the Delmarva Power and Light Company to initiate an intensive study of Delaware's largest



Figure 9. Kathy Parsons at Clark's Island heronry with Snowy Egret (*Egretta thula*) chicks. Photograph courtesy of William E. Davis, Jr.

heronry on Pea Patch Island in the Delaware River, a mixed colony of eight species of herons and ibises totaling about 7000 pairs. Jochen Wiese joined the staff as principal investigator to undertake this work. Wiese's study continued for four years, with subsequent work by Parsons, resulting in detailed nesting and foraging studies of one of the largest heronries on the Atlantic coast (Parsons 1995, Wiese et al. 1977).

BANDING AT MANOMET

From the first days as an Operation Recovery station, the banding of wild birds was an integral part of the research at Manomet. It was the mist-netting of migrant passerines that led to the formation of the Manomet Bird Observatory and subsequently lured the young people who became the first MBO interns, drew the teachers who brought their

classes to the bluff, and attracted the attention of the banders, birders, naturalists and conservationists who became the first supporters and MBO members.

Banding continues to be important at Manomet, the sheer numbers of birds banded and the extensive and careful data collected from each bird make Manomet records one of the largest such data bases in North America (Anderson 1982a). The initial banding while Manomet was still an Operation Recovery station had been recorded on a form developed by Anderson in the course of her work at the Encephalitis Field Station. At Manomet the banding form evolved as spaces for blood samples were eliminated and, with the arrival of Trevor Lloyd-Evans in 1972, spaces for details of molt were added. The forms were adopted by a dozen or more banding stations across the United States and Canada (e.g., Salvatori and Youngstrom 1973) (Figure 10).

Coming from Britain with extensive experience in both banding and migration studies at British bird observatories and on research expeditions to Portugal and Africa, Lloyd-Evans brought fresh perspectives as well as a gift for teaching (Figure 11). He tightened up banding procedures and protocols and provided a more academic educational experience for both volunteers and the growing number of student interns. As the records of birds handled grew, these data have led to studies of migration patterns (e.g., Williams et al. 1981), population changes (Hagan et al. 1991, 1992; Hill and Hagan 1991; Lloyd-Evans and Atwood 2004), a paper based on an analysis of banding records (Smith and Schneider 1979) and a paper correlating banding data and changing bird migration times and climate change.

Between August 1966 and the end of 2005, 231,307 birds of 160 species had been banded at Manomet (Figure 12). This number does not include the large number of birds banded by MBO researchers who banded herons, shorebirds, seabirds, and Neotropical birds during the course of research off-site.

Charts of birds captured per net hour for the years 1970-2005 show a steady decline with occasional spikes, probably a reflection of particular seasonal weather patterns. The 136,111 new bandings over the first 17.5 years (1966-83) averaged 7562/year while 95,196 new bandings over the past 22 years (1984-2005) averaged 4327/year. There was less coverage in spring and fall from 1966-1969, but effort (at least from 1970-2005) was very consistent in number of nets and hours. The



Figure 11. Trevor Lloyd-Evans. Photograph courtesy of Trevor.



Figure 12. MBO Banding room. Rosalie Fiske with back to camera at bench; Kathleen Anderson and Josephine Fernandez banding.

results show a steady decline in birds by almost exactly 50% over the 35 years.

The opportunity to handle large numbers of a variety of species led to a growing body of information on avian molt sequences (Lloyd-Evans 1983a) and measurement data. Recognizing that even experienced banders can produce variation in measurements taken from living birds, four such banders measured a group of birds repeatedly to test the significance of the variations (Nisbet et al. 1970).

Anderson's interest in avian ectoparasites did not end when she left the Encephalitis Field Station. Under her tutelage volunteers and interns continued to collect ticks, fleas, and lice found on the birds they handled. This resulted in three Manomet Research Reports and two publications (Main 1970, Main and Anderson 1970).

While still known as Manomet OR, mist nets had been occasionally set for shorebirds on the beach below the bluff, with only limited success because black nets set against a sandy beach in broad daylight were readily seen by the birds. Only when catching shorebirds became an integral tool for MBO's shorebird work did it become apparent that flushing roosting birds into black nets at high tide in the dark of night was the better procedure for capturing large numbers of migrant shorebirds. Banding herons and waterfowl required yet other techniques, which were developed and mastered as the needs required.

As an educational tool, nothing surpasses a live and lively colorful bird to hold the attention of an audience of any age, and birds provided their magic through the early years at MBO, for college biology classes learning details of avian physiology and migration, for elementary school classes getting their first close looks at wild birds, and for a variety of other adult groups where conservation was the message. Banding remains an integral part of the Manomet Center for Conservation Sciences program to this day.

As banding operations in North America turned to mist nets as a means of capturing those species of birds that could not be taken in baited traps, a reliable source for the purchase of nets became a necessity. Japanese nets were considered the best available, but importing them from Japan was difficult and time-consuming. Alexander Bergstrom, vice-president of the Northeastern Bird Banding Association (NEBBA) and editor of *Bird-Banding*, researched sources of Japanese nets and the legalities of importation. He then set in place an operation handling purchase, customs, sales, and shipping with proceeds going to NEBBA.

This became a great convenience for the growing numbers of banding operations relying on mist nets, including Anderson's work with the U.S. Public Health Service (Davis 2000).

Alex Bergstrom's unexpected death in 1973 precipitated a crisis for NEBBA, and for MBO, which had relied upon Bergstrom's operation as their source of quality nets. Kathleen Anderson, Brian Harrington, and other staff and volunteers were serving as officers of the NEBBA Council and were among those deciding what to do about this small but profitable service that had operated out of the Bergstrom home. MBO seemed the only expedient solution, with a financial structure, permanent staff, and space which could handle the business. MBO assumed the management of mist-net importation and distribution under Harrington's supervision with an agreement between the two organizations which covered MBO expenses but returned profits to NEBBA. The business expanded over time to include the sale of banding pliers and other essential equipment, continuing to the present time under agreement between the Association of Field Ornithologists (formerly NEBBA) and Manomet Center for Conservation Services (formerly MBO). Harrington has retired from Manomet but continues to supervise the business.

LAND BIRD RESEARCH AT MBO

Prior to August of 1972, MBO activities away from Widewater had been limited to assisting staff biologists of the Massachusetts Division of Fisheries and Wildlife (MDFW) in winter banding of Black Ducks (*Anas rubripes*) and to a contract for trapping and banding Mourning Doves (*Zenaida macroura*) during three summers.

When Trevor Lloyd-Evans joined the MBO staff in 1972 his primary responsibility was supervision of the banding program. His arrival at Manomet was also his first experience with North American birds, and the first weeks at MBO were an exciting introduction to a whole new avifauna in the hand. As he acquired more knowledge of New England habitats, Lloyd-Evans initiated studies of breeding bird populations in the pine barrens of the nearby Myles Standish State Forest and surrounding areas, demonstrating that the greatest diversity of breeding birds in these fire-prone forests occurred approximately 10 to 15 years after a burn, rather than in the most mature pitch pine (*Pinus rigida*)-

scrub oak (*Quercus ilicifolia*) growth. This study was followed by a succession of surveys of breeding birds; winter bird populations in a variety of other forest types; a hay-cropped coastal meadow; a stand of rich unburned old-growth situated on an island in a pond surrounded by forest typical of the pine barrens (Lloyd-Evans 1973, 1976, 1977a, 1979; Rimmer 1979) and to some contract studies of bird populations in other parts of Massachusetts (Litwin et al. 2003).

Concurrent with bird-banding, diverse short-term studies were undertaken by visiting scientists who often involved interns, providing them further perspectives, techniques, and avenues of research. In 1973 Raymond A. Stefanski, a post-doc at the Massachusetts Institute of Technology, initiated studies of Gray Catbird (*Dumetella carolinensis*) behavior and song patterns, a project which involved several interns. Timothy Williams and colleagues from Swarthmore College compared spring migration as indicated by mist-netting captures with ceilometer and radar studies at Manomet (Williams et al. 1981).

Because the House Finch (*Carpodacus mexicanus*) was just beginning its expansion into eastern Massachusetts, volunteer Elizabeth Smyth initiated a study of this burgeoning population by coordinating banding efforts of other volunteers at several locations in Massachusetts combined with studies of their molt regimes (Sorrie 1975c). One of the larger irruptions of Boreal Chickadees (*Poecile hudsonica*) into southern New England led Sorrie to research past invasions of this species in New England (Sorrie 1975b). Harrington's study of aggression in wintering White-throated Sparrows (*Zonotrichia albicollis*; Harrington 1973) was followed by work on dominance in wintering White-throated Sparrow and Dark-eyed Junco (*Junco hyemalis*) populations by intern William Allen of Carleton College. C. John Ralph, then a doctoral candidate at Johns Hopkins University, completed the field work for his dissertation on "Disorientation of Coastal Land Bird Migrants" and related studies while working at Manomet (Ralph 1981).

The presence at Manomet of so many young people with an avid interest in birds, constantly afield whether working or having time off, combined with the continual banding, led to unexpected sightings and to a rather thorough exploration of the bird life of the area (Anderson 1975, 1980, 1982b; Evered 1985; Hiam and Sutherland 1979; Petersen and Sorrie 1975; Sorrie 1974, 1975a,b,c).

A major conference on neotropical migrant landbirds was organized and hosted by Manomet in 1989, bringing many participants from

Latin America that led, among other things, to the publication of the proceedings by the Smithsonian Press (Hagan and Johnston 1992). Birders' Exchange also was founded at this meeting in response to statements by ornithologists from Latin America that the lack of equipment as basic as binoculars and ornithological texts seriously handicapped their ability to research their rich avifauna. Birders' Exchange arranges donations of used equipment in good condition (binoculars, telescopes, cameras, knapsacks, etc.); such equipment is then carried to recipient organizations by volunteer couriers, including birders, tour leaders, and businessmen, thereby reducing problems of loss or theft.

Successful fundraising provided for translation into Spanish, printing and distribution of *A Neotropical Companion*, John Kricher's (1989) acclaimed introduction to the animals, plants, and ecosystems of the New World Tropics, thus meeting a need that had been emphasized by academics and researchers at the 1989 Woods Hole Symposium. Birders' Exchange continues to grow and thrive under the direction of Betty Petersen.

AVIAN NUCLIDE PROJECT

The serendipitous location of a new boiling-water reactor commercial nuclear power station just up the coast from the Manomet Bird Observatory led to a multi-year research project studying the utility of using recapturable wild bird populations to monitor possible radionuclide emissions from the power plant. Kenneth A. Youngstrom, an MBO volunteer with an academic background in physics, saw the opportunity to use wild birds as on-site monitors of plant emissions and prepared a proposal. Initial funding from the Boston Edison Company in 1971 was followed by support from the United States Atomic Energy Commission and later by the U.S. Department of Energy.

With Youngstrom as Project Director, a whole-body gamma spectroscopic laboratory was constructed in the basement of MBO's headquarters building, the basement location necessitated by the tons of lead shielding the radiation counting chamber. Charles K. Levy, a Boston University physiologist, and Constantine J. Maletskos, a consultant in biophysics, were the principal investigators in this innovative attempt to detect radionuclides escaping into wildlife populations in the immediate vicinity of the nuclear power station.

Mist net sites were established on the Pilgrim Power Station site along with control sites 9 km to the south (coastal sites similar to the power station site) and 19 km to the southwest, inland from Plymouth Bay. Individuals of many passerine species were banded and captured repeatedly over the course of the study. Gamma spectra of many radionuclides, both natural and man-made, were recorded for comparison and analysis. Study populations included Mourning Dove (*Zenaida macroura*), Northern Bobwhite (*Colinus virginianus*), Ruffed Grouse (*Bonasa umbellus*), and Black Duck. Although it was possible to detect airborne byproducts of atmospheric nuclear testing by the Peoples Republic of China, half a world away, and to detect spikes of several fission products during the refueling of the Pilgrim Station reactor (when the reactor vessel was opened), there was no evidence to link the routine operation of the Plymouth nuclear power plant to the avian radionuclide concentrations detected (Levy et al. 1976, 1982).

The ability to perform repetitive non-destructive testing of free-ranging wild birds over the course of several years, together with the highly specific feeding habits of these birds brought a new awareness of the potential utility of the capture and identification skills (accepted as routine by avian field biologists) to the environmental physics community. The project was concluded in 1976 (Clay et al. 1979).

SHOREBIRD RESEARCH

Plymouth Beach, (about 8.8 km from MBO) is noted for attracting both a large number and variety of migrant shorebirds, especially in autumn. Trustee Joseph A. Hagar had studied the migration of shorebirds for many years and encouraged the staff to expand the work along the lines of his work on the migration strategies of the Hudsonian Godwit (Hagar 1966).

With Brian Harrington's (Figure 13) arrival in 1972 as Manomet's shorebird biologist, and encouraged by Hagar, intensive work began which led to a better understanding of shorebird populations. the new focus was primarily on the distribution and coastal ecology of shorebirds (plovers and sandpipers) among Canadian Arctic breeding grounds, migration routes, and wintering areas which extend as far as the southern tip of South America (Collazo et al. 1995; Duffy et al. 1981; Harrington 1978, 1984, 1992, 1993a,b, 1995; Harrington and

Leddy 1982b; Harrington and Schneider 1977, 1978; Harrington et al. 1986b, 2000; Morrison et al. 2000, 2001; Phister et al. 1992; Schneider 1978a,b, 1980, 1981a,b, 1985; Schneider and Harrington 1981; Schneider and Mallory 1982).

Harrington's first major focus was on migration strategies and food resources of the Semipalmated Sandpiper (*Calidris pusilla*) (Harrington 1982b, Harrington and Groves 1977, Harrington and Taylor 1982, Phister et al. 1998, Resende et al. 1989). Other research dealt with similar studies of the White-rumped Sandpiper (*Calidris fuscicollis*) and



Figure 13. MBO biologist Brian Harrington (right) and MBO intern erecting net for shorebirds on Plymouth Beach.

other species resulting in a number of publications on a variety of species of shorebirds (Anderson 1980, Brown et al. 2005, Groves 1978, Harrington and Hasse 1994, Harrington and Picone 1993, Harrington et al. 1991, Kasprysk et al. 1987, Mallory 1987, Mallory and Schneider 1979, Morrison et al. 1976, Schneider 1982b, Skeel and Mallory 1996).

The Red Knot (*Calidris canutus*) became of particular interest to Harrington, which led to many papers, a PBS special, and a book devoted to the species (Harrington 1982a, 1983, 1986, 2001; Harrington and Leddy 1982a; Harrington and Morrison 1980; Harrington et al. 1982; 1988; Morrison and Harrington 1992, Morrison et al. 1980; Schneider 1982b).

Harrington developed a close and cooperative relationship with R. I. G. Morrison of the Canadian Wildlife Service (CWS), who shared his belief that shorebirds should be studied as intercontinental, rather than North American, species, (Morrison and Harrington 1979). Jointly and separately, they encouraged the U.S. Fish and Wildlife Service, the Canadian Wildlife Service, and governments in Central and South America to recognize the importance of both interior wetlands and coastal beaches for the survival of shorebirds during migration and on their wintering grounds (Brown et al., 2001, 2002; Clarke et al. 1984; Galbraith et al. 1999, 2002; Harrington 1995, 1999; Harrington and Drilling 1996; Harrington and Morrison 1978; Harrington and Schneider 1977; Harrington et al. 1989, 1991; Morrison and Harrington 1979; Schneider 1985; Harrington et al. 1986b; Harrington et al. 1989; Morrison et al. 2001). Morrison also provided the opportunity for several MBO staff, interns and volunteers to participate in the extensive field work the CWS had undertaken on the west side of James Bay (Hagar 1966, Hagar and Anderson 1977, Morrison et al. 1976, Morrison and Harrington 1979).

Harrington's work on shorebird staging areas led to the formation of the International Shorebird Survey (ISS) in 1975 (Howe et al. 1989), a project involving more than 900 volunteer cooperators in both North and South America that stimulated the formation of the Western Hemisphere Shorebird Reserve Network (WHSRN) and whose shorebird counts continue to help identify sites needing protection (Myers et al. 1987a,b, Harrington and Perry 1996). With WHSRN in place, Harrington began a program to train professional wildlife managers in federal and state agencies across the United States and in Central and

South America in survey techniques, capture, and banding protocols for shorebirds, and habitat assessment and management.

David Schneider's arrival at Manomet in 1975 with his expertise in benthic invertebrates meshed perfectly with Harrington's need to understand the food resources which drew migrant shorebirds to Plymouth Beach (Figure 14). While Harrington measured and studied the physiology of the shorebirds, Schneider sampled the invertebrate populations on the mud flats as they waxed and waned during the period of shorebird migration (Schneider 1978a, Schneider and Harrington 1981). Shorebirds provide a classic example of morphological differentiation in feeding apparatus, which is traditionally explained by evolution to reduce competition. Despite differentiation, shorebirds often show high degrees of prey overlap, at all stages in their life cycle. Examples are high overlap on a few prey species at the North River estuary in



Figure 14. Pickup truck with MBO field researchers. Standing beside truck (left to right) Kevin Powers (seabirds), John Dugdale (intern), Brian Harrington (shorebirds), Galen Pittman (seabirds), Kathleen Anderson (driver). In bed of truck (left to right) unknown (standing), Miriam Axelrod, Martin Sutherland, Rick Heil, and Alex Hiam. Photograph courtesy of Manomet Center for Conservation Sciences.

Plymouth County, a high overlap on a few species on sandy beaches in the Eastern U.S. and Panama, and complete overlap on nereid worms at Newburyport, Massachusetts (Schneider and Harrington 1981). Shorebirds at Plymouth tended to select larger prey relative to the prey available in the environment (Schneider 1981a).

The global-scale research on invertebrate prey of shorebirds undertaken by MBO involved novel ways of looking at the biology of these long-distance migrants. The consistent patterns of prey depletion during southward migration suggested the hypothesis that early arrival of shorebirds in mid-latitude stopover habitat is driven by a competitive scramble for a predictably dwindling food supply at a critical point in their life cycle (Schneider and Harrington 1981). The entire life cycle can be viewed as a sequence of arrivals and departures adjusted to predictable seasonal pulses of prey productivity at different latitudes.

Harrington was also involved in a study of salt-marsh ditching in Essex County, Massachusetts, which focused on the effects of open-marsh management on birds, primarily shorebirds and waders (Brush et al. 1986, Wilson et al. 1987). Research on shorebird migration and ecology, proposed by J. A. Hagar and initiated by Harrington on Massachusetts beaches, has evolved to encompass the ecology and conservation of all North American shorebirds and the wetlands they require on both continents of the Western Hemisphere, certainly one of Manomet's greatest contributions to avian conservation.

David C. Schneider arrived at Manomet while a doctoral candidate at the State University of New York, Stony Brook. As a beginning graduate student (1973-1974) he had found that the combined effects of predation and selective choice of substrate were responsible for the observed patterns of spatial heterogeneity in benthic organisms in salt marsh pools. This stood in contrast to the then prevailing conceptual emphasis on the role of competition in structuring communities.

To see whether predation was an important structuring factor in other benthic communities, he undertook a series of studies of the effects of shorebird predation on patchiness of invertebrate prey on the inter-tidal flats in the lagoon bordered by the towns of Plymouth, Kingston, and Duxbury, which are just to the north of Manomet. A rough calculation in early 1975 showed that the food requirements of shorebirds were of the same order of magnitude as the standing stock of invertebrates at feeding sites in the lagoon. A pilot study on White Flat in 1975 (Schneider and Harrington 1981) showed that shorebirds

reduced prey densities by 50% or more during July and August. The study was extended to 13 sites in the lagoon in 1976-1979.

The study was further extended in 1979 to four sites in the North River estuary (Schneider and Harrington 1980, 1981). These studies showed that prey depletion was density dependent, rising to 90% at high density sites (Harrington and Groves 1977, Schneider 1978b). Shorebirds respond to prey patchiness (Mallory and Schneider 1979, Schneider and Harrington 1980, 1981) resulting in a reduction of prey patchiness (Schneider 1992). Predation was frequency dependent, falling most heavily on the most common prey species at any one site (Schneider 1978a). On a few occasions prey availability increased dramatically when invertebrates emerged from the sediment, where they were eaten by shorebirds and gulls. Emergence appeared to be in response to unusually high temperatures. Emergence events did not account for significant amounts of invertebrate mortality.

Studies of prey depletion rates were carried out at shorebird wintering grounds in 1979 and 1980 at four beaches in Panama (Schneider 1985) and in 1980 at three beaches in Argentina (Brayton and Schneider 2000). These studies showed little or no depletion during the months prior to departure from these wintering grounds. Thus, the major conservation implication of the benthic invertebrate research based at Manomet was that autumn stopover areas are more limiting with respect to food than is wintering habitat. This finding together with exhaustion of fat reserves during trans-oceanic autumnal migration (Schneider 1980) became a key argument for protecting feeding habitat along the southward (coastal) migration route.

When Stephen Brown joined the Manomet staff in 1998 he brought additional experience in wetlands restoration and ecology, important to shorebirds and other waterbirds (Brown 1998, 1999; Brown et al. 2001, 2002; Brown and Batzer 2001; Brown and Smith 1998; Brown and Verneman 2001). Recent trips to the Arctic have resulted in a widely acclaimed book which focuses on shorebirds (Brown 2006).

SEABIRD AND FISHERIES RESEARCH

Public discourse accompanying proposals to drill for oil on Georges Bank was an ongoing news topic in 1975 and led to MBO's first venture into seabird research. Initial funding by the U.S. Fish and

Wildlife Service led to development of a cost-effective program based on competent volunteers and a small cadre of paid biologists. Data collection began in 1976. Staff biologist Brian Harrington, who had been Biologist-in-Charge of certain seabird surveys for the Smithsonian Institution's Pacific Ocean Biological Survey Program before coming to MBO, drafted the first research proposal, based upon counting techniques he had used in the Pacific. MBO Trustee John F. Hubbard met with contacts at the Woods Hole office of the National Marine Fisheries Service (NMFS) and arranged for the first observer, intern Kerry Elkin, to go out on the *Albatross*, leaving in February 1976 for a plankton survey on Georges Bank.

As need was recognized for a better understanding of seasonal distribution and long-term changes in marine bird and mammal populations on the continental shelf of the Gulf of Maine, Georges Bank, and southern New England, MBO received invitations from NMFS to develop a program to measure and document these changes.

With internal funding, MBO hired Kevin D. Powers, who had recently finished work on a marine bird survey in coastal Alaska, part of a government assessment program launched in conjunction with the creation of the Alaskan pipeline project. Powers and David Schneider developed the early proposals to NMFS for work carried forward by Powers. The study was similar to other studies of seabirds in protocol and spatial extent, but it became unique in temporal extent when it passed the five-year mark. It was termed a "ships of opportunity" program because the observers were given free berth on NMFS research surveys and on some Russian and West German "factory ships" fishing off our shores. MBO had no control over when or where the ships went but neither was any cost incurred. With MBO staff and competent observers criss-crossing the offshore fishing grounds at virtually no expense, data collection was both copious and cost-effective (Powers 1979, Powers and Van Os 1979, Kerlinger et al. 1983, Payne et al. 1983).

In December 1976 an oil spill created by the grounding of the *Argo Merchant* oil tanker off Nantucket made it clear that this program was timely, as there had previously been little understanding of what bird populations were at risk (Powers and Loughlin 1977, Powers and Rumage 1978).

The MBO survey took on a more systematic approach in 1977 with regard to counting techniques. U.S. Coast Guard patrols from coastal

New England were added as another platform. The work focused on getting observations on Georges Bank during each month of the year, but additional cruises from southern New England south to Cape Hatteras were added as they became available. In 1979 a grant from the Fund for the Preservation of Wildlife and Natural Areas made possible a zooplankton identification project, providing for the collection of raw data on the distribution of surface-dwelling zooplankton in outer continental shelf waters of the North Atlantic (Powers and Backus 1987).

A 1988 contract with the U.S. Department of Energy provided funding that allowed for additional paid staff and travel money to get observers to ports from New Jersey to Maine. Research during the next two years focused on collecting data and building a database, resulting in the publication of several important papers in the early 1980s. One involved comparative methods of counting birds at sea (Powers 1982), another was the first analysis of pelagic distributions of marine birds off the northeastern U.S. (Powers 1983b). Other papers were generated from the work (Powers 1983a, 1987; Powers and Backus 1987; Powers and Brown 1987; Powers and Cherry 1983; Powers and Van Os 1979; Sealy et al. 1991).

MBO's work was comparable to pelagic range-extension work for eastern Canada by R. G. Brown of the Canadian Wildlife Service (Brown et al. 1975). Powers and Brown later combined their data collected from Nova Scotia to Cape Hatteras into a more comprehensive set of distribution maps (Powers and Brown 1987). Manomet's seabird data were used in a comparative study showing that the relation of seabirds to bathymetrically induced flow structures on Georges Bank was similar to that of seabirds in relation to similar structures (fronts and domains) in the southeastern Bering Sea (Hunt et al. 1981, Kinder et al. 1983, Schneider 1982c, Schneider et al. 1987).

The first analysis of seabird abundance at the time scale of ten years (Schneider and Heinemann 1996) showed different patterns in different species, most notably a long term drop in surface-scavenging species in the years after reductions in discards due to the legislated disappearance of foreign fishing fleets from Georges Bank. This same publication also summarized the status of shorebirds and coastal-nesting species in the Hatteras to Gulf of Maine region.

With the departure of Powers in 1983, with MBO's funding needs and the changing focus of the National Marine Fisheries Service (NMFS), the emphasis of the marine program switched from seabirds to

marine mammal population data. Michael Payne, an MBO staff member whose primary interest was in marine mammals, took over management of the marine program and expanded the initial work on coastal seals (Payne and Schneider 1984, Payne and Selzer 1984, Schneider et al. 1981) to emphasize surveys of deep-sea mammals. Michael Payne is now Chief of the Permits Division of the NMFS.

Later, again in response to changing NMFS needs, Manomet began pioneering work with the fishing industry under the direction of Christopher Glass, experimenting with ways to limit problems of marine mammals, seabirds, and sea turtles caught in fish nets (bycatch) as well as bottom-dwelling creatures caught up in and crushed by nets dragged along the sea floor (Glass 2000, 2001, 2004; Glass et al. 1998, 1999, 2001a,b, 2003, 2004; Glass and Gunn 2004; Jones et al. 2004; McCallum et al. 2000; Ozbilgin and Glass 2004). All work with deep marine vertebrates ended in 2006.

MANOMET'S WORK IN TROPICS AND NORTHERN FORESTS

In 1971 and 1972, Trustee Erma "Jonnie" Fisk sponsored two expeditions to British Honduras (later to become the independent country of Belize), to assist an American resident of that country, Dora Weyer, in studying and banding birds at a remote forestry camp in the southwestern corner of that country close to the Guatemalan border. Several new avian records for British Honduras resulted and Anderson made several subsequent visits to Belize. In 1983 and 1984 Manomet sent teams to Belize to census and band birds in a variety of Belizian habitats. They banded both resident tropical birds and those which breed in the north and winter in the tropics. Manomet staff and volunteers made up the team, among them former intern, and later banding assistant to Lloyd-Evans, Christopher Rimmer. Rimmer, is now Founding Director of the Vermont Center for Ecostudies. He has studied Bicknell's Thrush (*Catharus bicknelli*), both in Vermont and in the Dominican Republic (Atwood et al. 1996, Rimmer et al. 1996, 2001) as well as directing a variety of environmental research in Vermont.

In 1988 and 1989 Chandler Robbins of the U.S. Fish and Wildlife Service asked Anderson to assemble teams of volunteers to census and band birds in various agricultural habitats, in an effort to determine

which types of farms were being used by birds which breed in North America but winter in the Neotropical cacao and orange groves in 1988 and mango groves and pine forests in 1989. These various expeditions led to ongoing studies of Belizian birds and the tropical forests of Belize and other countries in the Neotropics, involving one of the first interns at MBO, Elizabeth (Betsy) Mallory together with Nicholas V. L. Brokaw and others (Mallory and Brokaw 1995; Mallory et al. 2004; Brokaw 1985a,b, 1986, 1987a,b, 1998a,b, 2001; Brokaw et al. 1990, 1997, 1998, 2004; Brokaw and Gear 1991; Brokaw and Lent 1999; Brokaw and Mallory 1985, 1990; Brokaw and Scheiner 1989; Brokaw and Walker 1991; Godoy et al. 1995, 1996, 1997, 1998, 2000, 2002; Kellman et al. 1994; Whitman 2004; Whitman et al. 1997a,b, 1998a,b).

Later John Hagan and Andrew Whitman turned their attention to the forests of Maine and the effects of various logging practices on bird life and forest ecology in general (Gunn and Hagan 2000, Hagan 1996, Hagan et al., 1996, 1997; Hagan and Meehan 2002, Hagan and Grove 1999, Hagan and Whitman 2006, Higdon et al., 2005; LeDoux and Whitman 2006, McWilliams et al., 2005).

POSTSCRIPT

Forty years after the founding of the Manomet Bird Observatory, much has changed. A new modern headquarters building was completed in 1989, set off at a safer distance from the surging ocean storms which eat away at the bluff below "Widewater." MBO is now the Manomet Center for Conservation Sciences and new research programs have focused on northern and tropical forests, by-catch problems with the offshore fisheries, and other topical research. Long-term banding and the heron and shorebird research continue, but the seawatch, seabird, marine mammal, and fisheries research, the broad educational programs, and the lively interns descending on Manomet from campuses across North America and beyond remain only as warm memories. The detailed historical record of the years between MBO's founding and 1983 are recounted in the preceding pages, and only brief descriptions of events in succeeding years. Details of the post-1983 years must be chronicled by someone who was on the scene at that time.

There has never been a compilation of the many contributions Manomet has made to ornithology and to conservation in general in

terms of published papers and unpublished reports. It was my decision, supported by WED, to include a complete bibliography of these contributions.

Manomet Bird Observatory was founded by a few people with a vision and the hope of providing a site and an opportunity for long-term studies of birdlife and other aspects of the natural history and ecology of this long-settled part of New England, always with the goal of aiding conservation. As I said early in Manomet's history, "everybody says somebody should be doing long-term research" but, as I soon discovered, foundations and government agencies do not want to commit to funding ongoing research without a predetermined end date. This presents a continuing problem for many research organizations. Short-term research cannot provide all the answers, not in medicine, not in biology, not in conservation of our natural resources. Manomet's future remains as unknown as the future of this storm-bound coast in a time of rising seas, but we wish it well.

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I am grateful to past and present staff members who generously refreshed my memory on details of their own research and involvement with the Manomet Bird Observatory during the years 1969-1983. Scientists who joined Manomet's staff subsequent to my involvement, some of whom I have never met, were just as generous with their time and helpful with details of their own research while at Manomet. On behalf of the MBO staff, and most particularly for myself, I thank all those eager, energetic, and fine young people, the Manomet interns, who gave so much of themselves to the research programs and to all the activities of the Manomet Bird Observatory. They were the yeast which kept it growing. All photographs are courtesy of Kathleen S. Anderson, unless otherwise noted.

MANOMET PUBLICATIONS AND LITERATURE CITED (Asterisks indicate cited papers)

Akcakaya, H. R., and J. L. Atwood. 1997. A habitat-based metapopulation model of the California Gnatcatcher. *Conservation Biology* 11:422-434.

- Akcakaya, H. R., J. L. Atwood, D. Breininger, C. T. Collins, and B. Duncan. 2003. Metapopulation dynamics of the California Least Tern. *Journal of Wildlife Management* 67:829-842.
- *Anderson, K. S. 1961. Eastern encephalitis in Massachusetts. *Bulletin of the Massachusetts Audubon Society* 45:86-89.
- *Anderson, K. S. 1965. Operation recovery at Duxbury Beach. *EBBA News* 28:187.
- *Anderson, K. S. 1975. First Massachusetts specimen of LeConte's Sparrow. *Auk* 92:145.
- *Anderson, K. S. 1977. The role of independent biological research stations. *Northern Raven* 5:1-2.
- *Anderson, K. S. 1979. Volunteer talents used by Manomet Bird Observatory. Pp. 33-37 in D. A. McCrimmon and A. Sprunt IV, eds., *Proceedings of a Conference on The Amateur and North American Ornithology*, 17-18 Feb. 1978, Cornell University, Ithaca, New York. Cornell University, Ithaca, New York.
- *Anderson, K. S. 1980. Least Sandpiper *Calidris minutilla* breeding in Massachusetts. *American Birds* 34:867.
- *Anderson, K. S. 1982a. Banding at Manomet Bird Observatory. *Audubon Society of Rhode Island Report* 17:1, 12.
- *Anderson, K. S. 1982b. Marbled Murrelet: a first Massachusetts record. *Bird Observer of Eastern Massachusetts* 10:349-352.
- *Anderson, K. S. 1990a. Joseph Archibald Hagar 1896-1989. *Manomet Bird Observatory Newsletter* 22(2):8-9.
- *Anderson, K. S. 1990b. Erma Johnson Fisk, 1904-1990. *Manomet Bird Observatory Newsletter* 22(2):9-10.
- *Anderson, K. S. 1991. In memoriam: Joseph Archibald Hagar, 1896-1989. *Auk* 108:954-955.
- *Anderson, K. S., and H. K. Maxfield. 1962. Sampling passerine birds in a wooded swamp in southeastern Massachusetts. *Wilson Bulletin* 74:383-385.
- *Anderson, K. S., E. J. Randall, A. J. Main, and R. J. Tonn. 1967. Netting at High Pines: a two-year all migratory survey of birds and arbovirus antibody activity at Duxbury Beach, Massachusetts. *Massachusetts Audubon* L(4):188-194.
- Arnold, M. E., F. B. Armitage, W. L. Bender, N. V. L. Brokaw, H. Hilmi, J. R. Palmer, and S. L. Pringle. 1989. *Belize Tropical Forestry Action Plan*. Overseas Development Administration, London, United Kingdom.
- Atwood, J. L. 1980. Social interactions in the Santa Cruz Island Scrub Jay. *Condor* 82:440-448.
- Atwood, J. L. 1986. Delayed nocturnal occupation of breeding colonies by Least Terns *Sterna antillarum*. *Auk* 103:242-244.
- Atwood, J. L. 1988. Speciation limits and geographic variation in Black-tailed Gnatcatchers. *Ornithological Monographs* No. 42.
- Atwood, J. L. 1991. Subspecies limits and geographic patterns of morphological variation in California Gnatcatchers *Poliophtila californica*. *Bulletin of the Southern California Academy of Science* 90:118-133.
- Atwood, J. L. 1992a. Inferred destinations of spring migrant Common Yellowthroats based on plumage and morphology. Pp.377-383 in J. M. Hagan and D. W. Johnston, eds., *Ecology and Conservation of Neotropical*

- Migrant Landbirds. Smithsonian Institution Press, Washington, D.C.
- Atwood, J. L. 1992b. A closer look: California Gnatcatcher. *Birding* 24:228-234.
- Atwood, J. L. 1993a. California Gnatcatchers and coastal sage scrub: the biological basis for endangered species listing. Pp. 149-169 in J. E. Keeley, ed., *Interface Between Ecology and Land Development in California*. Southern California Academy of Science, Los Angeles, California.
- Atwood, J. L. 1993b. The politics of protection. *Living Bird* 12:14-21.
- Atwood, J. L. 1994. A century of avifaunal change in western North America: endangered small land birds of the western United States. *Studies in Avian Biology* 15:328-339.
- Atwood, J. L., P. K. Bloom, D. Murphy, R. Fisher, T. Scott, T. Smith, R. Wills, and P. Zedler. 1997. *Principals of adaptive management for the southern Orange County NCCP*. The Nature Conservancy, Mission Viejo, California.
- Atwood, J. L., and J. S. Bolsinger. 1992. Elevational distribution of California Gnatcatchers in the United States. *Journal of Field Ornithology* 63:159-168.
- Atwood, J. L., and D. R. Bontrager. 2001. California Gnatcatcher *Poliophtila californica*. In A. Poole and F. Gill, eds., *The Birds of North America*, No. 574. The Birds of North America, Inc., Philadelphia, Pennsylvania.
- Atwood, J. L., M. J. Elpers, and C. T. Collins. 1990. Survival of breeders in Santa Cruz Island and mainland Scrub Jay populations. *Condor* 92:783-788.
- Atwood, J. L., V. L. Fitz, and J. E. Barnesberger. 1991. Temporal patterns of activity at leks of the White-bellied Emerald. *Wilson Bulletin* 103:373-386.
- Atwood, J. L., and B. W. Massey. 1988. Site fidelity of Least Terns in California. *Condor* 90:389-394.
- Atwood, J. L., and R. F. Noss. 1994. Gnatcatchers and development: a "train wreck" avoided? *Illahee* 10:123-130.
- Atwood, J. L., and C. H. Reynolds. 1998. Training manual: California Gnatcatcher survey techniques and background (Camp Pendleton Marine Corps Base, 1998.) Manomet Center for Conservation Sciences, Manomet, Massachusetts.
- *Atwood, J. L., C. C. Rimmer, K. P. McFarland, S. H. Tsai, and L. R. Nagy. 1996. Distribution of Bicknell's Thrush in New England and New York. *Wilson Bulletin* 108:650-661.
- Atwood, J. L., S. H. Tsai, C. A. Reynolds, and M. R. Fugagli. 1998. Distribution and population size of California Gnatcatchers on the Palos Verdes Peninsula, 1993-1997. *Western Birds* 29:340-350.
- *Baird, J., C. S. Robbins, A. M. Bagg, and J. V. Dennis. 1955. "Operation Recovery"—The Atlantic coastal netting project. *Bird-Banding* 29:137-168.
- Bart, J., B. Andres, S. Brown, G. Donaldson, B. Harrington, V. Johnston, S. Jones, G. Morrison, and S. Skagen. 2005. The Program for Regional and International Shorebird Monitoring (PRISM). Volume 2. Pp. 893-901, in C. J. Ralph and T. R. Rich, eds., *Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Symposium of Partners In Flight*. U.S.D.A. Forest Service, General Technical Report PSW-GTR-191. Pacific Southwest Research Station, Albany, California.

- *Bertin, R. I. 1975. Snowy Egrets attracted to prey by Common Terns. *Auk* 92:390-391.
- *Brayton, A. F., and D. C. Schneider. 2000. Shorebird abundance and invertebrate density during the boreal winter and spring at Peninsula Valdez, Argentina. *Waterbirds* 23:277-282.
- *Brokaw, N. V. L. 1985a. Gap-phase regeneration in a tropical forestry. *Ecology* 66:682-687.
- *Brokaw, N. V. L. 1985b. Treefalls, regrowth, and community structure in tropical forests. Pp. 53-69 in S. T. A. Pickett and P. S. White, eds., *The Ecology of Natural Disturbance and Patch Dynamics*. Academic Press, Orlando, Florida.
- *Brokaw, N. V. L. 1986. Seed dispersal, gap colonization, and the case of *Cecropia insignis*. Pp. 323-331 in A. Estrada and T. H. Fleming, eds., *Frugivores and Seed Dispersal*. W Junk, Dordrecht, The Netherlands.
- *Brokaw, N. V. L. 1987a. Gap-phase regeneration of three pioneer tree species in a tropical forest. *Journal of Ecology* 75:9-19.
- *Brokaw, N. V. L. 1987b. Algunos aspectos importantes en el estudio de la demografía de plantas en los bosques tropicales. *Revista de Biología Tropical* 35:205-206.
- Brokaw, N. V. L. 1991. Vegetation and tree flora near the camp of the Joint Services Scientific Expedition to the Upper Raspaculo. Pp. D-1 to D-1-11 in A. D. F. Rogers, and D. A. Sutton, eds., *The Upper Raspaulo River Basin, Belize, Central America*. The Natural History Museum, London.
- *Brokaw, N. V. L. 1998a. *Cecropia schreberiana* in the Luquillo Mountains of Puerto Rico. *Botanical Review* 64:91-120.
- *Brokaw, N. 1998b. Fragments past, present and future. *Trends in Ecology & Evolution* 13:382-383.
- *Brokaw, N. V. L. 2001. A history of plant ecology in Belize. *Journal of Belizean Affairs* 3:1-39.
- Brokaw, N. 2002a. Forest, Tropical. Pp. 101-103 in R. Robinson, ed., *Biology Vol. 2*. Macmillan Reference USA, New York.
- Brokaw, N. 2002b. La persistencia de las especies vegetales en los fragmentos de Bosque neotropical. Pg. 564-565 in M. Guariguata and G. Kattan, eds., *Ecología y Conservación de Bosques Neotropicales*. Libro Universitario Regional, Cartago, Costa Rica.
- Brokaw, N., and R. T. Busing. 2000. Niche versus chance and tree diversity in forest gaps. *Trends in Ecology and Evolution* 15:183-188.
- *Brokaw, N., S. Fraver, J. S. Gear, J. Thompson, J. K. Zimmerman, R. B. Waide, E. M. Everham III, S. P. Hubbell, and R. B. Foster. 2004. Disturbance and canopy structure in two tropical forests. Pp. 177-194 in E. C. Losos and E. G. Leigh, Jr., eds., *Tropical Forest Diversity and Dynamism: Results from a Large-scale Plot Network*. University of Chicago Press, Chicago, Illinois.
- *Brokaw, N. V. L., and J. S. Gear. 1991. Forest structure before and after Hurricane Hugo at three elevations in the Luquillo Mountains, Puerto Rico. *Biotropica* 23:386-392.
- *Brokaw, N. V. L., J. S. Gear, K. J. Tripplett, A. A. Whitman, and E. P. Mallory. 1997. The Quebrada de Oro forest in Belize: exceptional structure and high species richness. *Tropical Ecology* 38:247-458.
- *Brokaw, N. V. L., and R. A. Lent. 1999. Vertical structure. Pp 373-399 in M.

- L. Hunter, Jr., ed., *Maintaining Biodiversity in Forest Ecosystems*. Cambridge University Press, Cambridge, United Kingdom.
- Brokaw, N. V. L., and T. L. Lloyd-Evans. 1987. The Bladen Branch Wilderness [Belize]. Manomet Bird Observatory, Manomet, Massachusetts.
- *Brokaw, N. V. L., and E. P. Mallory. 1985. Experimental manipulation of tree population dynamics in a tropical forest. *National Geographic Society Research Reports* 21:47-49.
- *Brokaw, N. V. L., and E. P. Mallory. 1990. *Natural History and Environment of the Rio Bravo Resource Management and Conservation Area [Belize]*. Manomet Bird Observatory, Manomet Massachusetts.
- *Brokaw, N. V. L., E. P. Mallory, and P. W. Alcorn. 1990. *Trees of Rio Bravo: a guide to trees of the Rio Bravo Conservation and Management Area, Belize*. Manomet Bird Observatory, Manomet, Massachusetts.
- *Brokaw, N. V. L., and S. M. Scheiner. 1989. Species composition in gaps and structure of a tropical forest. *Ecology* 70:538-541.
- Brokaw, N., and J. Thompson. The H for DBH. *Forest Ecology and Management* 129:89-91.
- *Brokaw, N. V. L., and L. R. Walker. 1991. Summary of the effects of Caribbean hurricanes on vegetation. *Biotropica* 23:442-447.
- *Brokaw, N. V. L., A. A. Whitman, R. Wilson, J. M. Hagan, N. Bird, E. P. Mallory, L. K. Snook, P. J. Martins, D. Novelo, D. White, and E. Losos. 1998. Toward sustainable forestry in Belize. Pp. 225-239, *in* R. B. Primack, D. Bray, H. A. Galletti, and I. Ponciano, eds., *Timber, Tourists and Temples: Conservation and Development in the Maya Forest of Belize, Guatemala, and Mexico*. Island Press, Washington, D.C.
- *Brown, R. G. B., D. N. Nettleship, P. Germain, C. E. Tull, and T. Davis. 1975. *Atlas of eastern Canadian seabirds*. Canadian Wildlife Service, Ottawa.
- *Brown, S. 1998. Remnant seed banks and vegetation as predictors of restored marsh vegetation. *Canadian Journal of Botany* 76:620-629.
- *Brown, S. 1999. Vegetation similarity and avifaunal food value of restored and natural marshes in northern New York. *Restoration Ecology* 7:56-68.
- *Brown, S., (ed.). 2006. *Arctic wings: birds of the Arctic National Wildlife Refuge*. Mountaineer Books, Seattle, Washington.
- Brown, S., J. Bart, R. Lanctot, J. Johnson, S. Kendall, D. Payer, and J. Johnson. 2007. Shorebird abundance and distribution on the coastal plain of the Arctic National Wildlife Refuge. *Condor* 109:1-14.
- Brown, S. C., and D. P. Batzer. 2001. Birds, plants and macroinvertebrates as indicators of restoration success in New York marshes. Pp 237-248, *in* R. B. Rader, D. Batzer, and S. A. Wissinger, eds., *Bioassessment and Management of North American Freshwater Wetlands*. John Wiley and Sons, New York.
- *Brown, S. C., B. A. Harrington, K. C. Parsons, and E. P. Mallory. 2002. Waterbird use of northern Atlantic wetlands protected under the North American Wetlands Conservation Act. *Waterbirds* 25(Special Publication 2):106-114.
- *Brown, S., C. Hickey, B. Harrington, and R. Gill (eds.). 2001. *United States shorebird conservation plan*. Second edition. U.S. Fish and Wildlife Service, Washington, D.C.
- *Brown, S. C., S. Schulte, B. Harrington, B. Winn, J. Bart, and M. Howe. 2005. Population size and winter distribution of eastern American Oystercatchers.

Journal of Wildlife Management 69:1538-1545.

- *Brown, S. C., and C. R. Smith. 1998. Breeding season bird use of recently restored versus natural wetlands in New York. Journal of Wildlife Management 62:1480-1491.
- *Brown, S. C., and P. L. M. Veneman. 2001. Effectiveness of compensatory wetland mitigation in Massachusetts, USA. Wetlands 21:508-518.
- *Brush, T., R. A. Lent, T. Hraby, et al. 1986. Habitat use by salt marsh birds and response to open marsh water management. Colonial Waterbirds 9:189-198.
- *Burger, J., K. Parsons, T. Benson, T. Shukla, D. Rothstein, and M. Gochfeld. 1992. Heavy metal and selenium levels in young Cattle Egrets from nesting colonies in the northeastern United States, Puerto Rico, and Egypt. Archives of Environmental Contamination and Toxicology 23:435-439.
- Burger, J., K. Parsons, D. Wartenberg, C. Safina, J. O'Connor, and M. Gochfeld. 1994. Biomonitoring using Least Terns and Black Skimmers in the northeastern United States. Journal of Coastal Research 10:39-47.
- Bushing, R. T., and N. Brokaw. 2002. Tree species diversity in temperate and tropical forest gaps: the role of lottery recruitment. Folia Geobotanica 37:33-43.
- Byman, D., F. E. Wasserman, B. A. Schlinger, S. P. Battista, and T. H. Kunz. 1985. Thermoregulation of budgerigars exposed to microwaves (2.45 Ghz. CW) during flight. Physiological Zoology 58:91-104.
- Cavanaugh, P. A. (ed.). 2004. Southeastern Massachusetts Natural Resource Atlas: a regional guide to biodiversity. Manomet Center for Conservation Sciences, Manomet, Massachusetts.
- *Clarke, J. A., B. A. Harrington, T. Hraby, and F. E. Wasserman. 1984. The effect of ditching for mosquito control on salt marsh use by birds in Rowley, Massachusetts. Journal of Field Ornithology 55:160-180.
- *Clay, D. L., I. L. Brisbin, Jr., and K. A. Youngstrom. 1979. Age-specific changes in the major body components and caloric values of growing Wood Ducks. Auk 96:296-305.
- *Clough, T. R. 1977. Spring migration and food habits of Atlantic Brant *Branta bernicla hrota* at Duxbury Bay, Massachusetts. M.S. thesis, University of Massachusetts. Amherst.
- *Collazo, J. A., B. A. Harrington, J. S. Gear, and J. A. Colon. 1995. Abundance and distribution of shorebirds at the Cabo Rojo Salt Flats, Puerto Rico. Journal of Field Ornithology 66:424-438.
- *Czech, H. A., and K. C. Parsons. 2002. Agricultural wetlands and waterbirds; A review. Waterbirds 24 (Special Publication 2):56-65.
- *Davis, W. E., Jr. 1986. Effects of old nests on nest-site selection in Black-crowned Night-Herons and Snowy Egrets. Wilson Bulletin 98:300-303.
- *Davis, W. E., Jr. 1987. History of the Nuttall Ornithological Club 1873-1986. Memoir 11, Nuttall Ornithological Club, Cambridge, Massachusetts.
- *Davis, W. E., Jr. 1990. Herring Gulls nest on slanting roof. Bird Observer 18:96-98.
- *Davis, W. E., Jr. 2000. History of the Association of Field Ornithologists (Northeastern Bird-Banding Association). Pp. 263-309 in W. E. Davis, Jr. and J. A. Jackson, eds., Contributions to the History of North American Ornithology, Volume II. Memoirs of the Nuttall ornithological Club no. 13, Cambridge, Massachusetts.

- *Davis, W. E., Jr., and K. C. Parsons. 1982. The Clark's Island Heronry. *Bird Observer of Eastern Massachusetts* 10:124-131.
- *Davis, W. E., Jr., and K. C. Parsons 1991. Effects of investigator disturbance on the survival of Snowy Egret nestlings. *Journal of Field Ornithology* 62:432-435.
- *Davis, W. E., Jr., L. Smith, and B. A. Harrington. 1979. 1978 Census of heron and ibis nests at Clark's Island, Plymouth, Massachusetts. *Bird Observer of Eastern Massachusetts* 7:118-119.
- Demmer, J., R. Godoy, D. Wilkie, H. Overman, M. Taimur, K. Fernando, R. Gupta, K. McSweeney, N. Brokaw, S. Sriram, and T. Price. 2002. Do levels of income explain differences in game abundance an empirical test in two Honduran villages. *Biodiversity and Conservation* 11:1845-1868.
- *Duffy, D. C., N. Atkins, and D. C. Schneider. 1981. Do shorebirds compete on their wintering grounds? *Auk* 98:215-229.
- Duncan, C. 2006. The Western Hemisphere Shorebird Reserve Network (WHSRN). Pp. 682-686 in G. C. Boere, C. A. Galbraith, and D. A. Stroud, eds., *Waterbirds Around the World*. The Stationary Office, Edinburgh, United Kingdom.
- Duncan, C. 2007. Elaborando un Plan Nacional de Conservación de Aves Players: experiencias y pensamientos. Pp. 25-26 in R. Johnston-González, L. F. Castillo, and J. Murillo P., eds, *Conocimiento y Conservación de Aves Playeras en Colombia*, 2006. Asociación Calidris, Calidris, Colombia.
- *Evered, D. S. 1985. Pacific (and Arctic) loon identification: difficult, unfamiliarity and a little bit of confusion. *Bird Observer of Eastern Massachusetts* 13:10-14.
- Everham, E. D. III, and N. V. L. Brokaw. 1996. Forest damage and recovery from catastrophic wind. *Botanical Review* 62:113-185.
- Evers, D. C., R. P. Mason, N. C. Kamman, C. Y. Chen, A. L. Bogomoini, D. L. Taylor, C. R. Hammerschmidt, S. H. Jones, N. M. Burgess, K. Munney and K. C. Parsons. 2008. Integrated mercury monitoring program for temperate estuarine and marine ecosystems on the North American Atlantic coast. *Ecohealth* 5:426-441.
- Fraver, S., N. V. L. Brokaw, and A. P. Smith. 1998. Delimiting the gap phase in the growth cycle of a Panamanian forest. *Journal of Tropical Ecology* 14:673-681.
- *Galbraith, H., R. Jones, R. Park, J. Clough, S. Herrod-Julius, B. Harrington, and G. Page. 2002. Global climate change and sea level rise: potential losses of intertidal habitat for shorebirds. *Waterbirds* 25:173-183.
- *Galbraith, H., D. Park, R. Jones, S. Herrod-Julius, J. Clough, B. Harrington, and G. Page. 1999. Potential impacts of sea level rise due to global climate change on migratory shorebird populations at coastal sites in North America. Pp. 12-20 in J. Corven, ed., *Proceedings of the 6th Neotropical Ornithological Congress, International Shorebird Symposium*. Monterey, Mexico.
- *Glass, C. W. 2000 Conservation of fish stocks through bycatch reduction: a review. *Northeastern Naturalist* 7:395-410.
- *Glass, C. W. 2001. Bycatch reduction studies: fishermen and scientists working together. Pp. 24-25 in *Proceedings of 2nd North Atlantic Responsible Fishing Conference*, St. John's Newfoundland. November 2000. Marine Institute, St. John's Newfoundland, Canada.

- *Glass, C. W. 2004. Science and research panel summary. Pp. 9-12 in *Bycatch in Northeast Fisheries: Moving Forward*. Workshop proceedings. NOAA Fisheries Northeast Regional Office, Gloucester, Massachusetts.
- *Glass, C. W., H. A. Carr, B. Sarno, Y. Matsushita, G. Morris, T. Feehan and M. Poi. 2001a. Bycatch, discard and impact reduction in Massachusetts inshore squid fishery. ICES FTFB Working Group, Seattle, Washington. April 2001.
- *Glass, C. W., and J. Gunn. 2004. Influence of social behaviour and behavioural interactions in understanding temporal and spatial dynamics and their effect on availability and catchability. *ICES Journal of Marine Science* 61:1236-1237.
- *Glass, C. W., Y. Matsushita, and H. A. Carr. 2001b. Survey on the use of chafing gear and strengthening bags in trawl fisheries. ICES FTFB Working Group, Seattle April 2001.
- *Glass, C. W., B. Sarno, H. O. Milliken, G. D. Morris, and H. A. Carr. 1998. Squid *Loligo pealeii* reactions to towed fishing gears: the role of behaviour in bycatch reduction. *ICES CM* 1998/M:04.
- *Glass, C. W., B. Sarno, H. O. Milliken, G. D. Morris and H. A. Carr. 1999. Bycatch reduction in Massachusetts inshore squid *Loligo pealeii* trawl fisheries. *Marine Technology Society Journal* 33:35-42.
- *Glass, C. W., B. Sarno, G. D. Morris, and T. Feehan. 2003. The use of composite mesh codends to reduce bycatch and discard in North Atlantic fisheries. *ICES CM* 2003:Z:05.
- *Godoy, R., N. Brokaw, and D. Wilkie. 1995. The effect of income on the extraction of non-timber tropical forest products: model, hypotheses, and preliminary findings from the Sumu Indians of Nicaragua. *Human Ecology* 23:29-52.
- *Godoy, R., N. Brokaw, D. Wilkie, D. Colon, A. Palermo, S. Lye, and S. Wei. 1998. Of trade and cognition: markets and the loss of folk knowledge among the Tawahka Indians of the Honduran rain forest. *Journal of Anthropological Research* 54:219-233.
- *Godoy, R., N. Brokaw, D. Willkie, G. Cruz, A. Cubas, J. Demmer, K. McSweeney, and H. Overman. 1996. Rates of return on investments in cattle among Amerindians of the rain forest of Honduras. *Human Ecology* 24:395-399.
- *Godoy, R., K. O'Neill, S. Groff, P. Kosishack, A. Cubas, J. Demmer, K. McSweeney, J. Overmann, D. Willkie, N. Brokaw, and M. Martinez. 1997. Household determinants of deforestation by Amerindians in Honduras. *World Development* 25:977-987.
- *Godoy, R., H. Overman, J. Demmer, L. Apaza, E. Byron, T. Huanca, W. Leonard, E. Perez, V. Reyes-Garcia, kV., Vadez, D. Wilkie, A. Cubus, K. McSweeney, and N. Brokaw. 2002. Local financial benefits of rain forests: comparative evidence from Amerindian societies in Bolivia and Honduras. *Ecological Economics* 40:397-409.
- *Godoy, R., D. Wilkie, H. Overman, A. Cubus, G. Cubas, J. Demmer, K. McSweeney, and N. Brokaw. 2000. Valuation of consumption and sale of forest goods from a Central American rain forest. *Nature* 406:62-63.
- *Golden, N. H., B. A. Rattner, P. C. McGowan, K. C. Parsons, and M. A. Ottinger. 2003. Concentrations of metals in feathers and blood of nestling Black-crowned Night-Herons *Nycticorax nycticorax* in Chesapeake and

- Delaware Bays. *Bulletin Environmental Contamination and Toxicology* 70:385-393.
- *Groves, S. 1978. Age-related differences in Ruddy Turnstone foraging and aggressive behavior. *Auk* 95:96-103.
- Groves, S., and G. R. Peabody. 1975. Dead Herring Gull is found inside dead goosefish. *Bird-Banding* 46:76.
- *Gunn, J. S., and J. M. Hagan, III. 2000. Woodpecker abundance and tree use in uneven-aged managed, and unmanaged forest in northern Maine. *Forest Ecology and Management* 126:1-12.
- Hagan, J. M. 1992. Conservation biology when there is no crisis – yet. *Conservation Biology* 6:475-476.
- Hagan, J. M., III. 1993. Decline of the Rufous-sided Towhee in the eastern United States. *Auk* 110:863-874.
- Hagan, J. M. 1995. Environmentalism and the science of conservation biology. *Conservation Biology* 9:975-976.
- *Hagan, J. M. 1996. Clearcutting in Maine: would somebody please ask the right question? *Maine Policy Review* 5:7-19.
- *Hagan, J. M., and S. L. Grove. 1999. Coarse woody debris: humans and nature competing for trees. *Journal of Forestry* 97:6-11.
- *Hagan, J. M., III, and D. W. Johnston (eds.). 1992. *Ecology and conservation of neotropical migrant landbirds*. Smithsonian Institution Press, Washington, D.C.
- Hagan, J. M., and T. L. Lloyd-Evans. 1988. Home to a distant land. *Habitat* 5(6):19-23.
- *Hagan, J. M., T. L. Lloyd-Evans, and J. L. Atwood. 1991. The role of latitude in the timing of spring migration of North American landbirds. *Ornis Scandinavica* 22:129-136.
- *Hagan, J. M., T. L. Lloyd-Evans, J. L. Atwood, and D.S. Wood. 1992. Detecting population change using migration count data: a comparative approach. Pp.115-130 in J. M. Hagan and D. W. Johnston, eds., *Ecology and Conservation of Neotropical Migrant Landbirds*. Smithsonian Institution Press, Washington, D.C.
- *Hagan, J. M., P. S. McKinley, A. L. Meehan, and S. L. Gove. 1997. Diversity and abundance of landbirds in an industrial forest in Maine. *Journal of Wildlife Management* 61:718-733.
- *Hagan, J. M., and A. L. Meehan. 2002. The effectiveness of stand-level and landscape-level variables for explaining bird occurrence in an industrial forest. *Forest Science* 48:231-242.
- *Hagan, J. M., S. Pealer, and A. A. Whitman. 2006. Do small headwater streams have a riparian zone defined by plant communities? *Canadian Journal of Forest Research* 36:467-481.
- *Hagan, J. M., W. M. Vander Haegen, and P. S. McKinley. 1996. The early development of forest fragmentation effects on birds. *Conservation Biology* 10:188-202.
- *Hagan, J. M., and A. A. Whitman. 2006. Biodiversity indicators for sustainable forestry: simplifying complexity. *Journal of Forestry* 104:203-210.
- *Hagar, J. A. 1954. Northeastern flyway – a proposal for more effective waterfowl management in the New England coastal states and Long Island. Commonwealth of Massachusetts Division of Fisheries and Game, Bureau of Wildlife Research Management, Boston, Massachusetts.

- *Hagar, J. A. 1966. Nesting of the Hudsonian Godwit at Churchill, Manitoba. *Living Bird* 5:5-44.
- *Hagar, J. A. 1976. American Black Duck. Pp. 328-330, 333-336 in R. Palmer, ed., *Handbook of North American Birds*, Volume 2, Yale University Press, New Haven, Connecticut.
- *Hagar, J. A., and K. S. Anderson. 1977. Sight record of Eskimo Curlew *Numenius borealis* on West Coast of James Bay, Canada. *American Birds* 31:135-136.
- *Harrington, B. A. 1973. Aggression in winter resident and spring migrant White-throated Sparrows in Massachusetts. *Bird-Banding* 44:314-315.
- *Harrington, B. A. 1975. 1975 Census of waders at Clark's Island. *Bird Observer of Eastern Massachusetts* 3:167.
- *Harrington, B. A. 1978. Shorebird studies at Manomet Bird Observatory, Massachusetts. *Wader Study Group Bulletin* 23:44-45.
- *Harrington, B. A. 1982a. Untying the enigma of the Red Knot. *Living Bird Quarterly* 1:4-7.
- *Harrington, B. A. 1982b. Morphometric variation and habitat use of Semipalmated Sandpipers during a migratory stopover. *Journal of Field Ornithology* 53:258-262.
- *Harrington, B. A. 1983. The migration of the Red Knot. *Oceanus* 26:44-48.
- *Harrington, B. A. 1986. Species account, Red Knot. Pp. 871-886 in R. I. Di Silvestro, ed., 1986 Wildlife Report. National Audubon Society, New York.
- Harrington, B. A. 1987. Ecology, conservation, and management of seabirds – a review. *Ecology* 68:1130-1131.
- *Harrington, B. A. 1992. Review. Homeward bound: problems waders face when migrating from Banc D'Arguin, Mauritania, to their northern breeding grounds in Spring. *Wilson Bulletin* 104:761-764.
- *Harrington, B. A. 1993a. A coastal, aerial winter shorebird survey on the Sonora and Sinaloa coasts of Mexico, January 1992. *Wader Study Group Bulletin* 67:44-49.
- *Harrington, B. A. 1993b. Coastal globe-trotting–Shorebird migration in the New World. *Underwater Naturalist* 21:3-9.
- *Harrington, B. A. 1995. Shorebirds: east of the 105th meridian. Pp 57-60 in E. T. LaRoe, G. S. Farris, C. E. Puckett, P. D. Doran, and M. J. Mac, eds, *Our Living Resources*. U.S. Department of the Interior, National Biological Service, Washington, D.C.
- *Harrington, B. A. 1996. The flight of the Red Knot. W. W. Norton & Co., New York
- *Harrington, B. A. 1999. Shorebird migrations – fundamentals for land managers in the United States. Ducks Unlimited, Memphis, Tennessee.
- *Harrington, B. A. 2001. Red Knot (*Calidris canutus*). In A. Poole and F. Gill, eds., *The Birds of North America*, No. 563. The Birds of North America, Inc., Philadelphia, Pennsylvania.
- Harrington, B. A., P. T. Z. Antas, and F. Silva. 1986a. Observations of Common Terns in southern Brazil during April and May. *Journal of Field Ornithology* 57:222-224.
- *Harrington, B. A., P. T. Z. Antas, and F. Silva. 1986b. Studies of northward shorebird migration on the Atlantic coast of southern Brazil. *Vida Silvestre Neotropical* 1:45-54.
- Harrington, B., S. Brown, J. Corven, and J. Bart. 2002. Collaborative

- approaches to the evolution of migration and the development of science-based conservation in shorebirds. *Auk* 119:914-921.
- *Harrington, B. A., M. A. Cruz N., and A. Alvarez. 2000. Shorebirds during a brief survey in Tamaulipas, Mexico, January 2000. *International Wader Study Group Bulletin* 93:51-54.
- *Harrington, B. A., and S. Groves. 1977. Aggression in foraging migrant Semipalmated Sandpipers. *Wilson Bulletin* 89:336-338.
- *Harrington, B. A., and B. Haase. 1994. Latitudinal differences in sex ratios among nonbreeding Western Sandpipers in Puerto Rico and Ecuador. *Southwestern Naturalist* 39:253-254.
- *Harrington, B. A., J. A. Hagan, and L. E. Leddy. 1988. Site fidelity and survival differences between two groups of New World Red Knots *Calidris canutus*. *Auk* 88:439-445.
- *Harrington, B. A., and L. E. Leddy. 1982a. Sightings of knots banded and color-marked in Massachusetts in August 1980. *Journal of Field Ornithology* 53:55-57.
- *Harrington, B. A., and L. E. Leddy. 1982b. Are wader flocks random groupings? – a knotty problem. *Wader Study Group Bulletin* 36:20-21.
- *Harrington, B. A., F. J. Leeuwenberg, S. L. Resende, R. McNeil, B. T. Thomas, J. S. Grear, and E. F. Martinez. 1991. Migration and mass change of White-rumped Sandpipers in North and South America. *Wilson Bulletin* 103:621-636.
- *Harrington, B. A., and R. I. G. Morrison. 1980. Notes on the wintering area of Red Knot *Calidris canutus rufa* in Argentina, South America. *Wader Study Group Bulletin* 28:40-42.
- *Harrington, B. A., J. P. Myers, and J. S. Grear. 1989. Coastal refueling sites of global bird migrants. *Coastal Zone* 89. Pp. 4293-4307 in O. T. Magoon, H. Converse, D. Miner, L. T. Tobin, and D. Clark, eds., *Proceedings of the Sixth Symposium on Coastal and Ocean Management*. American Society of Civil Engineers, New York.
- *Harrington, B. A., and C. Picone. 1993. Hudsonian Godwit (*Limosa haemastica*) migration in southern Argentina. *Wader Study Group Bulletin* 67:41-44.
- *Harrington, B. A., and A. L. Taylor. 1982. Methods for sex identification and estimation of wing area in Semipalmated Sandpipers. *Journal of Field Ornithology* 53:174-177.
- *Harrington, B. A., D. C. Twitchell, and L. E. Leddy. 1982. Knots in Florida – a migration mystery. *Florida Naturalist* 55(December):4-5.
- *Hayes, R. O., J. Daniels, K. S. Anderson, M. Parsons, H. K. Maxfield, and L. A. LaMotta. 1962. Detection of EE virus and antibody in wild and domestic birds in Massachusetts. *American Journal of Hygiene* 75:183-189.
- *Hiam, A., and M. Sutherland. 1979. Ground nesting and related behavior of nighthawks (*Chordeiles minor*) in Massachusetts. *Bird Observer of Eastern Massachusetts* 7:98-105.
- *Higdon, J. W., D. A. MacLean, J. M. Hagan, and J. M. Reed. 2005. Evaluating vertebrate species risk on an industrial forest landscape. *Forest Ecology and Management* 204:279-296.
- Higdon, J. W., D. A. MacLean, J. M. Hagan, and J. M. Reed. 2006. Risk of extirpation for vertebrate species on an industrial forest in New Brunswick, Canada:1945, 2002, and 2027. *Canadian Journal of Forest Research*

36:467-481.

- *Hill, N. P., and J. M. Hagan, III. 1991. Population trends of some northeastern North American land birds: a half-century of data. *Wilson Bulletin* 103:165-182.
- *Howe, M. A., P. H. Geissler, and B. A. Harrington. 1989. Population trends of North American shorebirds based on the International Shorebird Survey. *Biological Conservation* 49:185-199.
- *Hunt, G. L., J. Kaiwi, and D. C. Schneider. 1981. Pelagic distribution of marine birds and analysis of encounter probability for the southeastern Bering Sea. Final Report to Office of Marine Pollution Assessment. *OCS Bird Studies* 16:1-160.
- *Jones, E. G., C. W. Glass, and H. O. Milliken. 2004. The reaction and behaviour of fish to visual components of fishing gears and the effect on catchability in survey and commercial situations. ICES FTFB Working Group, Gdynia, Poland. April 2004.
- Johnston, D. W., and J. M. Hagan. 1992. Long-term breeding bird censuses from eastern deciduous forests. Pp. 75-84 in J. M. Hagan and D. W. Johnston, eds., *Ecology and Conservation of Neotropical Migrant Landbirds*. Smithsonian Institution Press, Washington, D.C.
- Kasprzyk, M., R. A. Foster, and B. A. Harrington. 1987. First Northern Hemisphere record and first juvenile plumage description of the Cox's Sandpiper (*Calidris paramelanotos*). *American Birds* 41:1359-1365.
- *Kellman, M., Tackaberry, R., N. Brokaw, and J. Meave. 1994. Tropical gallery forests. *Research and Exploration* 10:92-103.
- *Kerlinger, P., J. D. Cherry, and K. D. Powers. 1983. Records of migrant hawks from the North Atlantic Ocean. *Auk* 100:488-490.
- *Kinder, T. H., G. L. Hunt, D. C. Schneider, and J. D. Schumacher. 1983. Oceanic fronts around the Pribilof Islands, Alaska: correlations with seabirds. *Eastern Coast Shelf Science* 16:309-319.
- *Kricher, J. C. 1989. *A Neotropical companion: an introduction to the animals, plants and ecosystems of the New World tropics*. Princeton University Press, Princeton, New Jersey.
- *LeDoux, C., and A. A. Whitman. 2006. Estimating the capital recovery costs of alternative patch retention treatments in eastern hardwoods. *International Journal of Forest Engineering* 17:21-30.
- *Levy, C. K., K. A. Youngstrom, and C. J. Maletskos. 1976. Whole-body gamma-spectroscopic assessment of environmental radionuclides in recapturable wild birds. Pp. 113-122 in C. E. Cushing, ed., *Radioecology and Energy Resources*. Dowden, Hutchinson, and Rost. Stroudsburg, Pennsylvania.
- *Levy, C. K., K. A. Youngstrom, and C. J. Maletskos. 1982. Radioecology on a nuclear power station site using recapturable wild birds and whole-body gamma-spectroscopic analysis. Pp. 329-343 in *Environmental Migration of Long-lived Radionuclides*, International Atomic Energy Agency, Vienna, Austria.
- *Litwin, R. S., T. L. Lloyd-Evans, and K. A. Halvorsen. 2003. Just passing through: migrant use of the Connecticut River Valley. Pp. 12-16 in J. Ortiz, D. Spector, P. Westover, and M. B. Wilson, eds., *Bird Finding Guide to Western Massachusetts*. University of Massachusetts Extension, Amherst, Massachusetts.

- *Lloyd-Evans, T. L. 1973. Pitch Pine – Scrub Oak forest. I. Mature, II. Regenerating. III. Recently Burned. *American Birds* 27:975-977.
- *Lloyd-Evans, T. L. 1976. Red Pine plantation, Pitch Pine-Scrub Oak forest I. Mature, II, Regenerating, III. Recently Burned. *American Birds* 30:1042-1043.
- *Lloyd-Evans, T. L. 1977a. Burned Pine-Oak forest, deciduous-coniferous low-lying island, Pitch Pine-Scrub Oak forest V. *American Birds* 31:50-51.
- *Lloyd-Evans, T. L. 1977b. Identification guide to European passerines, 2nd edition. (Review). *Wilson Bulletin* 89:191-192.
- *Lloyd-Evans, T. L. 1979. Hay-cropped meadow. Suburban housing development. Pitch Pine – Scrub Oak I. 15-year regeneration. *American Birds* 33:108-111.
- *Lloyd-Evans, T. L. 1983a. Incomplete molt of juvenile White-eyed Vireos in Massachusetts. *Journal of Field Ornithology* 54:50-57.
- Lloyd-Evans, T. L. 1983b. "Movements" section for *Hylocichla mustelina*, *Catharus guttatus*, *C. ustulatus*, *C. minimus*, *C. fuscescens* and *Turdus migratorius*. Pp. 925-1024. in S. Cramp, ed., *Handbook of the Birds of Europe, the Middle East and North Africa*. Oxford University Press, New York.
- *Lloyd-Evans, T. L., and J. L. Atwood. 2004. 32 years of changes in passerine numbers during spring and fall migrations in coastal Massachusetts. *Wilson Bulletin* 116:1-16.
- Lloyd-Evans, T. L., J. A. Hagar, B. A. Harrington, and K. D. Powers. 1980. The changing seasons. *American Birds* 34:750-754.
- Maccarone, A. D., J. N. Brzorad, and K. C. Parsons. 1993. Nest site selection of Herring Gulls in an urban estuary. *Colonial Waterbirds* 11:67-71.
- Maccarone, A. D., and K. C. Parsons. 1988. Differences in flight patterns among nesting ibises and egrets. *Colonial Waterbirds* 11:67-71.
- *Main, A. J. 1970. Distribution, seasonal abundance and host preference of fleas in New England. *Proceedings of the Entomological Society of Washington* 72:73-89.
- *Main, A. J., and K. S. Anderson. 1970. The genera *Ornithoica*, *Ornithomya*, and *Ornithoctona* in Massachusetts (Diptera: Hippoboscidae). 1970. *Bird-Banding* 41:300-306.
- Mallory, E. P. 1982. Territoriality in Whimbrels (*Numenius phaeopus hudsonicus*) wintering in Panama. *Wader Study Group Bulletin* 34:37-39.
- Mallory, E. P. 1987. Eskimo Curlew: A vanishing species? *Wilson Bulletin* 99:510-511.
- Mallory, E. P. 1988. Breeding waders in Europe (review). *Wilson Bulletin* 100:336-338.
- Mallory, E. P. 1995. Research statistics manual. Field Biology Training Program. Manomet Observatory for Conservation Sciences, Manomet, Massachusetts.
- *Mallory, E. P., and N. V. L. Brokaw. 1995. Neotropical migrant birds on riparian versus upland broadleaf forests in Belize. Pp. 255-256 in M. H. Wilson and S. A. Sader, eds., *Conservation of Neotropical Migratory Birds in Mexico, Los Tuxtlas, Veracruz, Mexico*. November 1993. Maine Agriculture and Forest Experiment Station Miscellaneous Publication 727, Orono, Maine.
- *Mallory, E. P., N. V. L. Brokaw, and S. C. Hess. 2004. Coping with capture

- rate bias: canopy height and several intrinsic factors. *Studies in Avian Biology* 29:151-165.
- *Mallory, E. P., and D. C. Schneider. 1979. Agonistic behavior of Short-billed Dowitchers feeding on a patchy resource. *Wilson Bulletin* 91:271-278.
- Massey, B. W., D. W. Bradley, and J. L. Atwood. 1992. Demography of a California Least Tern colony including effects of the 1982-1983 El Niño. *Condor* 94:976-983.
- *Matz, A. C., and K. C. Parsons. 2004. Organochlorines in Black-crowned Night Heron [sic] (*Nycticorax nycticorax*) eggs reflect persistent contamination in northeastern US estuaries. *Archives of Environmental contamination and Toxicology* 46:270-274.
- *McCallum, B., R. S.T. Ferro, and C. W. Glass. 2000. Report on the investigation of techniques to quantify fish behaviour from underwater videos and still photographs. ICES FTFB Working Group, Haarlem, Netherlands.
- *McWilliams, W. H., B. J., L. E. Caldwell, D. M. Griffith, M. L. Hoppus, K. M. Laustsen, A. J. Lister, T. W. Lister, J. W. Metzler, R. S. Morinm. S. A. Sader, L. B. Stewart, J. R. Steinman, J. A. Westfall, D. A. Williams, A. A. Whitman, and C. W. Woodall. 2005. The forests of Maine: 2003. U.S. Department of Agriculture, Forest Service, Northeastern Research Station, Resources Bulletin NE-16.
- *Morrison, R. I. G., R. E. Gill Jr., B. A. Harrington, S. Skagen, G. W. Page, C. L. Gratto-Trevor, and S. M. Haig. 2000. Population estimates of Nearctic shorebirds. *Waterbirds* 23:337-352.
- *Morrison, R. I. G., R. E. Gill Jr., B. A. Harrington, S. Skagen, G. W. Page, C. L. Gratto-Trevor, and S. M. Haig. 2001. Estimates of shorebird populations in North America. Occasional Paper, no. 104, Canadian Wildlife Service.
- *Morrison, R. I. G., and B. A. Harrington. 1979. Critical shorebird resources in James Bay and eastern North America. *Transactions of the North American Wildlife and Natural Resources Conference* 44:498-507.
- *Morrison, R. I. G., and B. A. Harrington. 1992. The migration system of the Red Knot *Calidris canutus rufa* in the New World, T. Piersma and N. Davidson, eds., *Wader Study Group Bulletin* 64(Supplement):71-84.
- *Morrison, R. I. G., B. A. Harrington, and L. E. Leddy. 1980. Migration routes and stopover areas of Red Knot *Calidris canutus* wintering in South America. *Wader Study Bulletin* 28:35-39.
- *Morrison, R. I. G., T. H. Manning, and J. A. Hagar. 1976. Breeding of Marbled Godwit *Limosa fedoa* at James Bay. *Canadian Field-Naturalist* 90:487-490.
- *Myers, J. P., R. I. G. Morrison, P. Z. Antas, B. A. Harrington, et al. 1987a. Conservation strategy for migratory species. *American Scientist* 75:19-26.
- *Myers, J. P., P. McLain, R. I. G. Morrison, P. Z. Antas, P. Canevari, B. A. Harrington, T. F. Lovejoy, et al. 1987b. The western hemisphere shorebird reserve network. *Wader Study Group Bulletin* 49(Supplement):122-124.
- *Nisbet, I. C., J. Baird, D. V. Howard, and K. S. Anderson. 1970. Statistical comparison of wing-lengths measured by four observers. *Bird-Banding*, 41:307-308.
- Nisbet, I. C., and W. H. Drury. 1969. A migration wave observed by moon-watching and at banding stations. *Bird-Banding*. 40:243-254.
- *Ozbilgin, H., and C. W. Glass. 2004. Role of learning in mesh penetration behaviour of haddock *Melanogrammus aeglefinus*. *ICES Journal of Marine*

Science 61:1190-1194.

- *Parsons, K. C. 1981. Nesting growth in early- and late-nesting Black-crowned Night-Herons. *Colonial Waterbirds* 4:120-125.
- *Parsons, K. C. 1982. Nest-site selection and hatching success of gulls. *Colonial Waterbirds* 6:131-138.
- *Parsons, K. C. 1994. The Arthur Kill oil spill: biological effects in birds. Pp. 215-237 in, J. Burger, ed., *Before and After an Oil Spill*. Rutgers University Press, New Brunswick, New Jersey.
- *Parsons, K. C. 1995. Heron nesting at Pea Patch Island, Upper Delaware Bay, USA: abundance and reproductive success. *Colonial Waterbirds* 18:69-78.
- *Parsons, K. C. 1996. Recovering from oil spills: the role of proactive science in mitigating adverse effects. *Colonial Waterbirds* 19:149-153.
- *Parson, K. C. 2002. Integrated management of waterbird habitats at impounded wetlands in Delaware Bay, USA. *Waterbirds* 25(Special Publication 2):25-41.
- *Parsons, K. C. 2003. Reproductive success of wading birds utilizing *Phragmites* marsh and upland nesting habitats. *Estuaries* 26/2B:596-601.
- *Parsons, K. C., S. C. Brown, R. M. Erwin, H. A. Czech, and J. C. Coulson. 2002. Managing wetlands for waterbirds: integrated approaches. *Waterbirds* 25:1-4.
- *Parsons, K. C., and J. Burger. 1982. Human disturbance and nesting behavior in Black-crowned Night-Herons. *Condor* 84:184-187.
- *Parsons, K. C., and J. Chao. 1983. Nest cover and chick survival in Herring Gulls (*Larus argentatus*). *Colonial Waterbirds* 6:154-159.
- Parsons, K. C., A. D. Maccarone, and J. Brzorad. 1991. First breeding record of Double-crested Cormorant *Phalacrocorax auritus* in New Jersey. *Records of New Jersey Birds* 17:51-52.
- *Parsons, K. C., and T. L. Master. 2000. Snowy Egret (*Egretta thula*). In A. Poole and F. Gill, eds., *Birds of North America*, no. 489. The Birds of North America, Inc., Philadelphia, Pennsylvania.
- *Parsons, K. C., A. C. Matz, M. J. Hooper, and M. A. Pokras. 2000. Monitoring wading bird exposure to agricultural chemicals using serum cholinesterase activity. *Environmental Toxicology and Chemistry* 19:1317-1323.
- *Parsons, K. C., and A. C. McColpin. 1995. Great Blue Heron reproductive success in upper Delaware Bay. *Journal of Field Ornithology* 66:184-191.
- *Parsons, K. C., S. R. Schmidt, and A. C. Matz. 2001. Regional patterns of wading bird productivity in northeastern U.S. estuaries. *Waterbirds* 24:323-330.
- Parsons, K. C., J. E. Yacabucci, S. R. Schmidt, and N. A. Hurwitz. 2009. Dermestid beetles inhabiting wading bird nests in northeastern US estuaries. *Northeastern Naturalist* 16:415-422.
- Payne, L. X., B. A. Harrington, and S. A. Temple. 1999. Dispersion patterns of migratory shorebirds: implications for conservation. Pp. 12-20 in *Proceedings of the 6th Neotropical Ornithological Congress, International Shorebird Symposium*. Monterey, Mexico.
- *Payne, P. M., K. D. Powers, and J. E. Bird. 1983. Opportunistic feeding on whale fat by Wilson's Storm-Petrels in the western North Atlantic. *Wilson Bulletin* 95:478-479.
- *Payne, P. M., and D. C. Schneider. 1984. Yearly changes in abundance of harbor seals at a winter haul-out site in Massachusetts. *Fisheries Bulletin*

82:440-442.

- *Payne, P. M., and L. Selzer. 1984. The distribution, abundance and selected prey of the harbor seal (*Phoca vitulina*) in southern New England. *Marine Mammal Science* 5:173-192.
- *Petersen, W. R. 1971. Scoter studies at MBO. *Massachusetts Wildlife* 22:7-9.
- *Petersen, W. R. 1973. Project Seawatch – focusing in on the scoters. *Cape Naturalist* 1:58-60.
- *Petersen, W. R. 1983. The flight of the sea coot: a look at autumn scoter migration. *Bird Observer of Eastern Massachusetts* 11:193-197.
- *Petersen, W. R., and B. A. Sorrie. 1975. Winter birding in the Plymouth-Manomet area. *Bird Observer of Eastern Massachusetts* 3:4-6.
- *Phister, C., B. A. Harrington, and M. Lavine. 1992. The impact of human disturbance on shorebirds at a migration staging area. *Biological Conservation* 60:115-126.
- *Phister, C., M. J. Kasprzyk, and B. A. Harrington. 1998. Body fat levels and annual return in migrating Semipalmated Sandpipers. *Auk* 115:904-915.
- *Powers, K. D. 1979. Lesser Black-backed Gull *Larus fuscus* in Labrador waters. *Canadian Field-Naturalist* 93:445-446.
- *Powers, K. D. 1982. A comparison of two methods of counting birds at sea. *Journal of Field Ornithology* 53:209-222.
- *Powers, K. D. 1983a. How seabirds adapt to ocean processes. *Oceanus* 26:11-17.
- *Powers, K. D. 1983b. Pelagic distributions of marine birds off the northeastern United States. NOAA Technical Memorandum NMFS-F/NEC-27, U.S. Department of Commerce, NOAA, Woods Hole, Massachusetts.
- *Powers, K. D. 1987. Seabirds. Pp. 194-201 in J. D. Milliman and W. R. Wright, eds., *The Marine Environment of the U.S. Atlantic Continental Slope and Rise*. Jones and Bartlett, Sudbury, Massachusetts.
- *Powers, K. D., and E. H. Backus. 1987. Energy transfer to seabirds. Pp. 372-374 in R. H. Backus, ed., *Georges Bank*. M.I.T. Press, Cambridge, Massachusetts.
- *Powers, K. D., and R. G. B. Brown. 1987. Seabirds. Pp. 359-371 in R. H. Backus, ed., *Georges Bank*. M.I.T. Press, Cambridge, Massachusetts.
- *Powers, K. D., and J. Cherry. 1983. Loon migrations off the coast of northeastern United States. *Wilson Bulletin* 95:125-132.
- *Powers, K. D., and W. T. Ramage. 1978. Effect of the Argo Merchant oil spill on bird populations off the New England coast, 15 December 1976 – Jan 1977. Pp. 142-148 in K. Sherman, ed., *In the Wake of the Argo Merchant – Proceedings of a symposium held January 11-13, 1978 at the Center for Ocean Management Studies, University of Rhode Island, Kingston, Rhode Island*.
- *Powers, K. D., and J. M. Loughlin. 1977. Oiling of seabirds from the Argo Merchant incident. *Pacific Seabird Group Bulletin* 4:27-28.
- *Powers, K. D., and J. A. Van Os. 1979. A concentration of Great Shearwaters in the western North Atlantic. *American Birds* 33:253.
- Putz, F. E., and N. V. L. Brokaw. 1989. Sprouting of broken trees on Barro Colorado Island, Panama. *Ecology* 70:538-541.
- *Ralph, C. J. 1981. Age ratios and their possible use in determining autumn routes of passerine migrants. *Wilson Bulletin* 93:164-168.
- *Rattner, B. A., J. Joffman, M. J. Melancon, G. H. Olsen, S. R. Schmidt, and

- K. C. Parsons. 2000. Organochlorine and metal contaminant exposure and effects in hatching Black-crowned Night-Herons *Nycticorax nycticorax* in Delaware Bay. Archives of Environmental Contamination and Toxicology 39:38-45.
- *Resende, S. L., F. Leeuwenberg, and B. A. Harrington. 1989. Biometrics of Semipalmated Sandpipers *Calidris pusilla* in southern Brazil. Wader Study Group Bulletin 55:25-26.
- *Rimmer, C. C. 1979. Hay-cropped meadow. Pitch Pine-Scrub Oak Forest. Winter Bird-Population Study. American Birds, 33:20, 50.
- *Rimmer, C. C., J. L. Atwood, K. P. McFarland, and L. R. Nagy. 1996. Population density, vocal behavior, and recommended survey methods for Bicknell's Thrush. Wilson Bulletin 108:639-649.
- *Rimmer, C. C., K. P. McFarland, W. G. Ellison, and J. E. Goetz. 2001. Bicknell's Thrush *Catharus bicknelli*. In A. Poole and F. Gill, eds., The Birds of North America, no. 592. The Birds of North America, Inc., Philadelphia, Pennsylvania.
- Salvadori, A., and K. A. Youngstrom. 1973. A system survey for a bird observatory: Part I. A recording form for banding data. Bird-Banding 44:249-257.
- Schreiber, E. A., C. J. Feare, B. A. Harrington, B. G. Murray, Jr., W. B. Robertson, Jr., M. J. Robertson, and G. E. Woolfenden. 2002. Sooty Tern (*Sterna fuscata*). In A. Poole and F. Gill, eds., The Birds of North America, no. 665. The Birds of North America, Inc., Philadelphia, Pennsylvania.
- *Schneider, D. C. 1978a. Equalisation of prey numbers by migratory shorebirds. Nature 271:353-354.
- *Schneider, D. C. 1978b. Selective predation and the structure of marine benthic communities. Ph.D. dissertation, SUNY, Stony Brook, New York.
- *Schneider, D. C. 1980. Food enough for a marathon flight? Aquasphere 14:8-15.
- *Schneider, D. C. 1981a. Size-selective predation on mysides by birds (Plovers). Marine Ecology-Progress Series 5:223-224.
- *Schneider, D. C. 1981b. Food supplies and the phenology of migratory shorebirds: a hypothesis. Wader Study Group Bulletin 33:43-45.
- Schneider, D. C. 1982a. Escape responses of an infaunal clam, *Ensis directus* Conrad 1843, to a predatory snail, *Polinices duplicatus* Say 1822. Veliger 24:371-372.
- *Schneider, D. C. 1982b. Predation by Ruddy Turnstones (*Arenaria interpres*) on a polymorphic clam (*Donax variabilis*) at Sanibel Island Florida. Bulletin of Marine Science 32:341-344.
- *Schneider, D. 1982c. Fronts and seabird aggregations in the southeastern Bering Sea. Marine Ecology – Progress Series 10:101-103.
- Schneider, D. C. 1983. The food and feeding of migratory shorebirds. Oceanus 26:38-43.
- *Schneider, D. C. 1985. Migratory shorebirds: resource depletion in the tropics? Ornithological Monographs 36:546-558.
- Schneider, D. C. 1987. Patch structure of benthic populations on an intertidal sandflat. Oceanologica Acta 10:469-473.
- *Schneider, D. C. 1992. Thinning and clearing of prey by predators. American Naturalist 139:148-160.
- *Schneider, D. C., and B. A. Harrington. 1981. Timing of shorebird migration

- in relation to prey depletion. *Auk* 98:197-220.
- *Schneider, D. C., and D. Heineman. 1996. The state of marine bird populations from Cape Hatteras to the Gulf of Maine. Pp. 197-216 in K. Sherman, N. A. Jaworski, and T. J. Smayda, eds., *The Northeast Shelf System: Stress, Mitigation, and Sustainability*. Blackwell, London.
- *Schneider, D. C., G. L. Hunt, and K. D. Powers. 1987. Energy flux to pelagic birds: a comparison of Bristol Bay and Georges Bank. Pp 259-277 in J. P. Croxall, ed., *Seabirds: Feeding Ecology and Role in Marine Ecosystems*. Cambridge University Press, Cambridge, United Kingdom.
- *Schneider, D. C., and E. P. Mallory. 1982. Spring migration of shorebirds in Panama. *Condor* 84:344-345.
- Schneider, D. C., and P. M. Payne. 1983. Factors affecting haul-out numbers of harbor seals (*Phoca vitulina*) at a site in southeastern Massachusetts. *Journal of Mammalogy* 64:518-520.
- *Sealy, S. G., H. R. Carter, W. D. Shuford, K. D. Powers, and C. A. Chase III. 1991. Long-distance vagrancy of the Asiatic Marbled Murrelet in North America, 1979-1989. *Western Birds* 22:145-155.
- Skagen, S. K., J. Vart, B. Andres, S. Brown, G. Donaldson, B. Harrington, V. Johnston, S. Jones, and R. I. G. Morrison. 2003. Monitoring the shorebirds of North America towards a unified approach. *Wader Study Group Bulletin* 100:1-3.
- *Skeel, M. A., and E. P. Mallory. 1996. Whimbrel *Numenius phaeopus*. In A. Poole and F. Gills, eds., *The Birds of North America*, no. 219. The Academy of Natural Sciences, Philadelphia, Pennsylvania and the American Ornithologists' Union, Washington, D.C.
- *Sorrie, B. A. 1974. Probable nesting of the Yellow-breasted Chat in Sandwich. *Bird Observer of Eastern Massachusetts* 2:74.
- *Sorrie, B. A. 1975a. Alder and Willow flycatchers in Massachusetts. *Bird Observer of Eastern Massachusetts* 3:48-50.
- *Sorrie, B. A. 1975b. Boreal Chickadee invasions. *Bird Observer of Eastern Massachusetts* 3:165-166.
- *Sorrie, B. A. 1975c. The House Finch in Massachusetts. *Bird Observer of Eastern Massachusetts* 3:192-193.
- *Spitzer, P. L., and A. Poole. 1980. Coastal Ospreys between New York City and Boston: a decade of reproductive recovery 1969-1971. *American Birds* 34:234-241.
- Stafford, P. J., and E. P. Mallory. 2002. Egg-laying habits of the Middle American arboreal lizard *Laemactus longipes*, with particular reference to nest site selection. *Herpetological Bulletin* 79:30-32.
- Tackaberry, R., N. Brokaw, M. Kellman, and E. Mallory. 1997. Estimating species richness in tropical forest: the missing species extrapolation technique. *Journal of Tropical Ecology* 13:449-458.
- Thompson, B. C., J. A. Jackson, J. Burger, L. A. Hill, E. M. Kirsch, and J. L. Atwood. 1997. Least Tern *Sterna antillarum*. In A. Poole and F. Gill, eds., *The Birds of North America*, no. 290. The Academy of Natural Sciences, Philadelphia, Pennsylvania and The American Ornithologists' Union, Washington, D.C.
- Thompson, J., N. Brokaw, J. K. Zimmerman, R. B. Waide, E. M. Everham III, D. J. Lodge, C. M. Taylor, D. Garcia-Montiel, and M. Fluet. 2002. Land use history, environment, and tree composition in a tropical forest. 2002.

- Ecological Applications 12:1344-1363.
- Vallely, A. C., and A. A. Whitman. 1998. The birds of Hill Bank, northern Belize. *Cotinga* 8:39-49.
- Walker, L. R., N. V. L. Brokaw, D. J. Lodge, and R. B. Waide (eds). 1991. Ecosystem, plant, and animal responses to hurricanes in the Caribbean. *Biotropica* 23(special issue):313-521.
- Walker, L. R., D. J. Lodge, N. V. L. Brokaw and R. B. Waide. 1991. Hurricanes in the Caribbean. *Biotropica* 23:313-316.
- Wasserman, F. E., C. Dowd, D. Byman, B. A. Schlinger, S. P. Battista, and T. H. Kunz. 1984. Aversion/attraction of Blue Jays to microwave irradiation. *Physiology & Behavior* 33:805-807.
- Wasserman, F. E., C. Dowd, B. Schlinger, S. P. Battista, and T. H. Kunz. 1984. The effects of microwave radiation on avian dominance behavior. *Bioelectromagnetics* 5:331-339.
- Wasserman, F. E., C. Dowd, D. Byman, B. A. Schlinger, S. P. Battista, and T. H. Kunz. 1985. Thermoregulatory behavior of birds in response to continuous wave 2.45 Ghz microwaves radiation. *Physiological Zoology* 58:80-90.
- Wasserman, F. E., C. Dowd, B. Schlinger, S. P. Battista, and T. H. Kunz. 1985. The effects of microwave radiation on avian dominance behavior. *Bioelectromagnetics* 5: 331-339.
- Wasserman, F. E., T. L. Lloyd-Evans, S. P. Battista, D. Byman, and T. H. Kunz. 1985. The effect of microwave radiation (2.45.GHz CW) on molt of House Finches *Carpodacus mexicanus*. *Space Solar Power Review* 5:261-270.
- Whigam, D. F., M. B. Dickinson, and N. V. L. Brokaw. 1999. Background canopy gap and catastrophic wind disturbances in tropical forests. Pp. 223-252 in L. R. Walker, ed., *Ecosystems of Disturbed Ground*. Elsevier, Amsterdam, The Netherlands.
- *Whitman, A. A. 2004. The use of mist nets for study of Neotropical bird communities. Pp. 161-167 in Ralph, C. J., and E. H. Dunn, eds, *Monitoring Bird Populations Using Mist Nets Studies*. *Studies in Avian Biology* 29.
- *Whitman, A. A., N. V. L. Brokaw, and J. M. Hagan, III. 1997a. Forest damage caused by selection logging of mahogany (*Swietenia macrophylla*) in northern Belize. *Forest Ecology and Management* 92:87-96.
- Whitman, A. A., and J. M. Hagan. 2007. An index to identify late-succesional forest in temperate and boreal zones. *Forest Ecology and Management* 246:144-154.
- *Whitman, A. A., J. M. Hagan III, and N. V. L. Brokaw. 1997b. A comparison of two bird survey techniques used in a subtropical forest. *Condor* 99:955-965.
- *Whitman, A. A., J. M. Hagan, and N. V. L. Brokaw. 1998a. Effects of selective logging on tropical forest birds in Belize. *Biotropica* 30:449-457.
- *Whitman, A. A., M. L. Hunter, Jr., and J. W. Witham. 1998b. Age distribution of ramets of a forest herb, wild sarsaparilla, *Aralia nudicaulis* (Araliaceae). *Canadian Field-Naturalist* 112:37-44.
- Whitman, A. A., and P. M. Payne. 1991. Age of harbour seals, *Phoca vitulina concolor*, wintering in southern New England. *Canadian Field-Naturalist* 104:579-582.
- *Wiese, J. H., W. R. Davidson, and V. F. Nettles. 1977. Large scale mortality

- of nestling ardeids caused by nematode infection. *Journal of Wildlife Diseases* 13:376-382.
- Wilkerson, E., J. M. Hagan, D. Siegel, and A. A. Whitman. 2006. The effectiveness of different buffer widths for protecting headwater stream temperature in Maine. *Forest Science* 52:221-231.
- *Williams, T. C., J. E. Marsden, T. L. Lloyd-Evans, V. Krauthamer, and H. Krauthamer. 1981. Spring migration studied by mist-netting, ceilometer, and radar. *Journal of Field Ornithology* 52:177-190.
- Wilson, J. R., N. Beck, R. Bech, J. Briggs, N. Brokaw, S. Iremonger, B. Miller, T. Rath, and C. Santos. 1995. Towards a National Protected Area Systems Plan for Belize. NARMAP, Belmopan, Belize.
- *Wilson, W. H., T. Brush, R. A. Lent, and B. A. Harrington. 1987. The effects of grid-ditching and open marsh water management on avian utilization of the Atlantic flyway. Delaware Coastal Zone Management Program, Delaware Natural Resources, Dover, Delaware.
- Zimmerman, J. K., E. M. Everham, III, R. B. Waide, D. J. Lodge, C. M. Taylor, and N. V. L. Brokaw. 1994. Responses of tree species to hurricane winds in subtropical wet forest in Puerto Rico: implications for tropical tree life histories. *Journal of Ecology* 82:911-922.
- Zink, R. F., G. F. Barrowclough, J. L. Atwood, and R. C. Blackwell-Rago. Genetics, taxonomy, and conservation of the threatened California Gnatcatcher. *Conservation Biology* 14:1394-1405.

MANOMET RESEARCH REPORTS

In addition to the bibliography above, Manomet published in house 11 reports of on-going research. Copies are available for inspection at the Manomet Center for Conservation Biology library.

- Petersen, W. R. 1971. A preliminary study of scoter migration in southeastern Massachusetts. Research Report no. 1, Manomet Bird Observatory, Manomet, Massachusetts.
- Main, A. J., and K. S. Anderson. 1971. Avian ectoparasites at Manomet Bird Observatory: Part I. Scutate ticks. Research Report no. 2, Manomet Bird Observatory, Manomet, Massachusetts.
- Main, A. J., and K. S. Anderson. 1971. Avian ectoparasites at Manomet Bird Observatory: Part II. Fleas, Flies. Research Report no. 3, Manomet Bird Observatory, Manomet, Massachusetts.
- Bedard, A. O. 1971. The European Edible Periwinkle *Littorina littorea* (Linneas) and some new symbiotic associates. Research Report no. 4, Manomet Bird Observatory, Manomet, Massachusetts.
- Sorrie, B. A. 1972. Flora of Long Beach, Plymouth, Massachusetts. Research Report no. 5, Manomet Bird Observatory, Manomet, Massachusetts.
- Sorrie, B. A. 1974. A preliminary annotated flora of the Manomet Bird Observatory. Research Report no. 6, Manomet Bird Observatory, Manomet, Massachusetts.
- Lloyd-Evans, T. L. 1974. The ornithology and vegetation of a burnt-over pitch

pine forest in Plymouth County. Research Report no. 7, Manomet Bird Observatory, Manomet, Massachusetts.

Lloyd-Evans, T. L. 1975. The ornithology and vegetation of sample plots in Plymouth County, Massachusetts. Research Report no. 8, Manomet Bird Observatory, Manomet, Massachusetts.

Sorrie, B. A., 1975. Rediscovery of *Psilocarya nitens* in New England. Research Report no. 9, Manomet Bird Observatory, Manomet, Massachusetts.

Lloyd-Evans, T. L. 1976. Report on bird banding 1966-1975. Research Report no. 10, Manomet Bird Observatory, Manomet, Massachusetts.

Bedard, A. O. 1977. New distribution records for the Calico Crab *Ovalipes ocellatus* from Massachusetts waters north of Cape Cod. Research Report no. 11, Manomet Bird Observatory, Manomet, Massachusetts.

APPENDIX 1

Manomet Bird Observatory Interns 1969-1982

<u>1969:</u>	
Arnold, Eve	1969 - 1970
Bauer, Susan	1969 - 1970
Bishop, Donald	
Bishop, Jay	
Smith, Kimberly G. "Kim"	1969 - 1970
<u>1970:</u>	
Amory, Susan	
Anderson, Kathleen M.	
Chapin, Samuel	1970 & 1974
Everett, Stephen L.	
Fisher, Timothy	
Fisk, Molly	
Gifford, Stephen	
Hartel, Karsten	1970 - 1971
Houghton, Natalie	1970 - 1973
Jones, Martin	1970 - 1971
Mallory, Elizabeth P.	1970 - 1977
Nichols, Lucy	1970 - 1972
Russo, Ethan	
Shiftlett, James	

Tryon, Cynthia	
Vaughan, Lois	1970 - 1971
Wait, Dallas	

1971:

Clark, Valana	1971 - 1972
Donahue, Paul	1971 - 1973
Gamwell, Scott	1971 - 1972
Hart, Douglas	
Husk, Richard "Dick"	1971 - 1972
Kinney, Elizabeth	
Loughlin, James (Jay)	1971 - 1973
Mayer, Barbara (Bobbie)	1971 - 1972
Van Der Mark, Fiep	

1972:

Atwood, Frederick	
Bellows, Susan	1972 - 1973 & 1975
Berson, Elizabeth (Betsy)	
Doughty, April	1972 - 1973
Falcone, Paul	
Groves, Sarah	1972 - 1976
Munves, Margaret	
Recke, Susan	
Thibodeau, Frederic	

1973:

Charif, Russell	
Danielson, Karen	
Elkin, Kerry	1973 - 1974
Garton, Janice (Jan)	
Hamill, Ralph	1973 - 1974
Jenkins, Wallace (Wally)	
Mandelbaum, Ilene	
Noji, Eric	
O'Brien, Patricia (Patti)	

Olin, Margaret
 Post, Peter
 Richardson, Philip
 Smith, William
 Thomas, James
 Twichell, Elizabeth
 Yarsites, Jean
 Wyman, Charles (Charlie)

1974:

Addelson, Barbara	1974 - 1976
Burke, Andrea	
Cotton, Pamela	
Fisher, Martha	
Hallowell, Sarah	
Hill, David	
Landmesser, William	
McKittrick, Mary	
Norton, Robert (Rob)	
Parsons, Stuart	1974 - 1975 & 1977
Peabody, George	
Regnier, Emily	
Smith-Kenneally, Thomas	
Symonds, Fraser	
Wachman, Stephen	

1975:

Allen, William	
Atkins, Natasha (Tash)	1975 - 1976
Bertin, Robert (Bob)	
Cammack, Elizabeth (Binky)	
Clough, Thomas	1975 - 1976
Downer, Randy	
Furfey, Rosemary	
Hutson, Jean	
Lannon, Marcia	
Light, Steven	1975 - 1976
Linn, Mark	

Moore, Michael	1975 - 1976
Navrotsky, Susan	1975 - 1976
Rimmer, Christopher (Chris)	1975 & 1978
Sobal, David	
Szepan, Susan	
Turner, Charles	

1976:

Caldwell, Katharine (Kathy)	
Dowd, Christina (Tina)	1976 - 1977
Ehlers, Samuel	
Fix, David	
Haber, Carol	1976 - 1978
Hay, Mia	
Kruser, Ben	1976 - 1977
Scharf, Craig	1976 - 1977
Simon, Alan	
Taylor, Avery	1976 & 1980

1977:

Bailey, Brent	
Cannell, Peter	
Corroon, Robert	
Dykstra, Mary	
Fitch, Susan	
Hopkins, Elizabeth (Libby)	
Ledec, George	
Repka, Rita	
Tofias, Lauren	
Van Os, Joseph	1977 - 1978
Weiss, Katie	
Woodward, Hobson	

1978:

Axelrod, Miriam	1978 - 1979
Dugdale, John	
Hayward, David	
Heil, Richard (Rick)	

Hiam, Alexander	1978 - 1979
Leddy, Linda	
Lee, Lucy	
MacLachlan, Andrew	1978 - 1979
Mason, Ann	
McGraw, Linda	
Perkins, Eleanor (Missy)	1978 - 1979
Riccitelli, Joanne	1978 - 1979
Shockey, Barbara	
Stephenson, Roger	
Sutherland, Martin	
Welton, Melinda	

1979:

Blake, Chip	
Fitton, Samuel	
Hinckley, Sarah	
Holcomb, Dorothy (Dotty)	
Jones, Kyle	
Kasprzyk, Mark	
Kesselheim, Craig	
Kremers, Walter (Wally)	
Magner, Maryann	
Marsden, Ellen	1979 - 1980
McHugh, Jan	
Miller, Dorcas	
Moon, David (Dave)	
Nelson, Todd	
Pace, Sara	
Palmer, Mary	
Schlinger, Barney	
Tessaglia, Diane	
Tuckerman, Russell	

1980:

Assmann, Sarah
Cherry, Jeff
Del Raso, Nick

Doyle, Sheila
Gonzales, Christian
Haslam, Renee
Kotliar, Natasha
Long, Suzanne
Most, Maxanne
Nichols, Willlliam
Payne, Laura
Sargent, Sarah
Stangel, Peter
Van Buskirk, Josh
Weinstein, Evie

1980 - 1981

1981:

Alstrom, Per
Chick, Michael
Cohen, Susan
DeLuca, Diane
Dinkeloo, Hanni
Gard, Barbara
Gotwald, Vicki
Hanna, Dave
Highsmith, Tod
Maynard, Bill
Merker, Dave
Mitton, John
Woodrey, Mark
Young, Joanne
Zakrzewski, Mitch

1981 - 1982

1982:

Ansel, Talvi
Baird, Steve
Burson, Shan
Carmel, Randell
Drake, Beezie
Evered, Duncan
Hecklau, John

Leo, Leslie	
Lundgren, Julie	
Messick, Lyla	
Moore, Martha	
Novak, Paul	
Selzer, Larry	
Shattuck, Patricia	
Sommers, Laura	1982 - 1983
Yaukey, Peter	
Zadorozny, Maggie	

1983:

Bryan, Sandra	
Calabrese, Kathy	
Crane, Penny	
Crossman, Thomas	
Gustafson, Judy	
Heise, Anne	
Hurwitz, Adam	
McQuade, Priscilla	
Robbins, Russell	
Sibley, David	
Swanson, David	
Tarnow, Karen	
Therrien, Gerard	
Van Stockum, Willem	
Walsh, Joan	

Other volunteers who spent varying amounts of time at Manomet before the intern program was developed or who came later as visiting scientists:

Griffin, Stephen	1966 - 1968
Metcalf, Lawrence (Larry)	1966 - 1972
Shumway, Donald	1966
Tose, Leslie	1966 - 1973
Barrowclough, George	1968
Sutcliffe, Scott	1968 - 1971
Vaughn, Allen	1968 - 1969
Vaughn, Milton	1968 - 1969

Hill, Blair	1970
Walker, Marcia	1970
Sanders, Stewart	1971 - 1973
Braunhardt, Denise	1972
Brown, Alexandra	1972
Stull, William B.	1972
Keohan, Mary Lou	1973
Main, Andrew J.	1973
Perkins, Simon	1973
Ralph, C. John (CJ)	1973
Zachiam, Hugh	1973

John Richardson's Contributions to North American Ornithology

*C. Stuart Houston*¹

ABSTRACT. –Acknowledged as a leading scientist, and undoubtedly the most distinguished of the many surgeon-naturalists in the history of the British Empire, John Richardson spent nearly eight years in what is now Canada. He was the naturalist assigned to both overland Arctic exploring expeditions led by John Franklin, 1819-1821 and 1823-1825, and he led the first overland searching expedition, 1848-1849, after Franklin's third arctic expedition had been missing for three years. His contributions to North American ornithology, particularly his authorship of the first three volumes of the *Fauna Boreali-Americana*, deserve more recognition than they have received.

Through a combination of caprice and random chance, complicated by what might best be described as “the slings and arrows of outrageous fortune” (from Shakespeare's *Hamlet*, 1603), John Richardson's contributions to North American ornithology have received less credit than he deserves (Figure 1). His name is not as well-known today as that of his commander, John Franklin, a plodding and unimaginative leader whose judgment left much to be desired, or of William Swainson, his artist and co-author. We still have Franklin's Gull (*Leucophaeus pipixcan*), Swainson's Hawk (*Buteo swainsoni*), and Swainson's Thrush (*Catharus ustulatus*), but Richardson's Merlin (*Falco columbarius richardsonii*) [American Ornithologists' Union, hereafter AOU, 1957:121], Richardson's Owl (*Aegolius funereus richardsoni*) [AOU 1957:288], and Richardson's Wood Pewee (*Myiochanes richardsoni richardsoni*) [AOU 1931:210] are names no longer in use.

I offer an in-depth study of the man, based on the journals of all three officers: Robert Hood, Richardson (Figure 2), and George Back, who served under Franklin (Houston 1974, 1984, 1994), and a study of

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Figure 1. Portrait of John Richardson, ca. 1829, age ca. 43 years. Crayon portrait by Negelen from *Arctic Artist*, p. xxiii, courtesy C. S. Houston and McGill - Queen's University Press.

the Richardson-Swainson correspondence in the Linnean Society of London (Houston 1988). I also explain the important contributions of Richardson's assistants: Robert Hood in 1819-1821, and Thomas Drummond in 1825-1827. My understanding was enhanced by tours of the Royal Naval Hospital Haslar, and the lake district of England, especially Grasmere and Lancrigg, and by visits to Dumfries and Edinburgh in Scotland, the Scott Polar Research Institute in Cambridge, and the Linnean Society headquarters in London. My wife, Mary, and I participated in a ten-day "following Franklin" study of the Bathurst Inlet campsites visited exactly 158 years earlier by Franklin's party. A char-

we at length made a fire - It was not sufficient, however, to warm the whole party, much less to thaw our shoes, and no tripe de roche being gathered we had nothing to cook.

Course S.W. by compass - (Distance 5 1/2 miles.)

Sunday October 7th 1821

Cold & clear weather - Left the encampment about nine and a little before noon came to a pretty extensive thicket of small willows. Here Mr Hood, John Hephurn, and myself determined to remain, and our tent being pitched Mr Franklin read prayers and took a very affectionate leave of us - His baggage consisting only of a single blanket, and the officers' journals, added very little to the men's loads, which were now reduced to their personal clothing and a single tent. No tripe de roche to day. Drank an infusion of the Ledum palustre.

The melancholy circumstances attendant on the deaths of Mr Hood and Michel (who returned to us, on the 9th) and the other painful occurrences, until the 29th of this month when after a most distressing journey Hephurn and myself reached the house, have been detailed in an account drawn up and transmitted home, I shall not therefore enter upon a subject so harrowing to my feelings here - but proceed at once to

Monday October 29th 1821.

When we entered Fort Enterprise, in the dusk of the evening, and had the melancholy satisfaction of embracing Mr Franklin. No language that I can use, being adequate to convey a just idea of the wretchedness of the abode, in which we found our commanding officer, I shall not make

tered flight allowed us to follow the path of Thomas Drummond's journey east and north from Jasper, Alberta.

John Richardson was the most distinguished of the many British surgeon-naturalists, according to Lloyd and Coulter (1963) in their definitive work, *Medicine and the Navy, 1200-1900*. Yet neither McIlraith's (1868) biography, published three years after Richardson's death, nor Johnson's (1976) biography written over a century later, fully recognized his achievements as a naturalist, nor did they explain that Richardson was the sole author of volumes 1 and 3, and the pre-eminent author of volume 2, of *Fauna Boreali-Americana*.

John Richardson was born at Dumfries, Scotland, on 5 November 1787, the first of 12 children of brewer Gabriel Richardson and his wife Anne Mundell. A precocious boy, John learned to read at four years of age and was apprenticed to his surgeon uncle at the age of 13. For six winters during his apprenticeship he studied at Edinburgh, obtaining his LRCS (Licentiate degree) from the Royal College of Surgeons in 1807. He was then appointed assistant surgeon with the Royal Navy. During the War of 1812-1814, he served with the Royal Marines in actions against the United States, visiting Halifax, Montreal, St. Jean on the Richelieu River, and Quebec City. He participated in the two-month occupation of Cumberland Island, north of the Georgia-Florida boundary, 10 January through 10 March 1815, until the British garrison belatedly learned that the war had concluded with the Treaty of Ghent on 24 December 1814.

Returning to Scotland on half-pay, Richardson studied natural history at the University of Edinburgh under the renowned Professor Robert Jameson and completed a thesis, in Latin, on yellow fever, for his advanced Doctor of Medicine degree in August 1816. He practiced medicine in Leith, the port of Edinburgh, for two years until his appointment by the Royal Navy as surgeon and naturalist to Franklin's first Arctic Land Expedition of 1819-1822.

The Royal Navy, whenever it explored and claimed new territory for the British Empire, employed a surgeon-naturalist. Such a man could assess, from the plant species present, the potential productivity of the land. He could also identify coal or precious minerals that might be present. He collected and identified mammals and birds, especially those of value for food or fur. Full-time naturalists were then extremely scarce, but a select few were employed in top medical colleges to teach

botany and zoology. A graduate medical doctor who had impressed his teachers with his knowledge of these two subjects, in addition to the usual surgeon's skills in suturing wounds, lancing boils, setting fractures, and treating illness, was the usual recruit for the position of surgeon-naturalist.

With few exceptions, only medical students had access to university courses in zoology and botany. In the English-speaking world, Edinburgh was particularly renowned for the quality of such instruction. Zoology was important in the study of comparative anatomy. Herbal remedies were crucial; for example, doctors could not treat dropsy unless they could recognize and make an infusion from the leaves of the foxglove (*Digitalis purpurea*), nor could they treat scurvy unless they recognized appropriate plant remedies, including scurvy-grass (*Cochlearia officinalis*).

Russia had led other countries when they hired German surgeons who were also naturalists, beginning with Georg Wilhelm Steller, in 1741, the first naturalist to step on Alaskan soil (Mearns and Mearns 1992), and later Peter Simon Pallas (Stresemann 1975), and G. H. Langsdorff (Pearse 1968). Richardson's illustrious predecessors from Great Britain included William Anderson, surgeon with James Cook's second voyage (1776-1778), and Archibald Menzies, surgeon-naturalist on the round-the-world trips of H.M.S. *Prince of Wales* (1786-1789) and H.M.S. *Discovery* under George Vancouver (1790-1794). The United States later emulated Britain in appointing a surgeon-naturalist to each of its western exploring parties (Hume 1942).

Surgeon-naturalist to the first Franklin expedition, 1819-1822.—On 25 March 1819, Sir John Barrow, the Secretary to the Admiralty, offered Richardson a position with the forthcoming Franklin expedition to the Arctic. He wrote:

"If you feel disposed for such an expedition, and think that your health and qualifications are suitable for the undertaking, and you could be ready to set out from England by the first week in May, I request you to state to me whether you could undertake to collect and preserve specimens of minerals, plants, and animals . . ." (McIlraith 1868:59-60).

When Richardson accepted, he wrote to his father from London on 24 April 1819:

“The country has never been visited by a naturalist, and presents a rich harvest. My knowledge of these subjects is very limited, but I am endeavouring to extend it by the opportunities afforded me here, and if I succeed in making a good collection, I have no doubt of my promotion on my return.” (McIlraith 1868:64).

Richardson’s modesty belies the fact that he was already a competent geologist, lichenologist, botanist, and mammalogist. His exemplary list of lichens collected near Fort Enterprise in 1820-1821 illustrates his extraordinary acumen. He relied on Acharius’s *Lichenographia Universalis* (1810), written in Latin, for identification. Appendix E in *Arctic Ordeal* (Thomson 1984) demonstrates that most of the lichen species named and described in Latin by Richardson remain readily recognizable today, and that from evidence in Richardson’s hand-written journal he should be credited for the descriptions of both *Cetraria richardsonii* and *Dactylina arctica*, which until 1984 had been attributed to William J. Hooker (Thomson 1984).

Richardson’s botanical expertise allowed him to recognize arctic plant species that were different from those in Europe. During the first Franklin expedition he collected 690 species of plants, 31 of them new to science, from the interior and northern coast of British North America, published in his remarkably complete botanical appendix to Franklin’s *Journey* (Franklin 1823, Richardson 1823, 1824). He added another 11 new plant species during the second expedition, 1825-1827 (Hooker 1840).

Richardson’s obituary notice in the *American Journal of Science* (Anonymous 1866:265) correctly observes: “The work by which his name is indelibly associated with American botany is his botanical appendix to Franklin’s first overland journey, published in 1823, the most important essay of the time upon Arctic plants, and the precursor of Hooker’s *Flora of British America*.”

On the first Franklin expedition, Richardson also collected three new taxa of ground squirrels (Sabine 1822). All natural history specimens collected during the first nine months, perhaps half or more of them from Cumberland House, were sent back to Britain. There, inappropriately, the Earl of Bathurst, Secretary for War and the Colonies, gave the birds and mammals to Joseph Sabine to describe and then deposit in the British Museum. Sabine, although keenly interested in all phases of natural history, a charter member of the Linnean Society, and

already a Fellow of the Royal Society, was a lawyer until 1808, when he was appointed one of ten Inspectors-General of Taxes. In 1823, his chief avocation was botany; he was Honorary Secretary of the Horticultural Society, “which he ruled despotically” (Boulger and Goldbloom 2004:24438).

On his safe return to Britain in late October, 1822, John Franklin was furious to learn that Sabine had been loaned Richardson’s initial bird and mammal specimens and that Sabine’s paper on the three new ground squirrels was already in press. Although Sabine (1822, 1823) thereby usurped Richardson’s priority, he was gentleman enough to name the three ground squirrels for Franklin, Richardson, and Hood. Parenthetically, Joseph Sabine was the elder brother of Edward Sabine, who collected the type specimen of Sabine’s Gull on 25 July 1818, when serving under Captain John Ross in an exploring journey along the west coast of Greenland; Joseph was guilty of nepotism when he commemorated his family name by applying *sabinei* to the gull in honor of his brother who had collected it (Mearns and Mearns 1988:475).

The bird specimens collected by Richardson during the nine days after arrival at York Factory (31 August to 8 September 1819) had been rendered almost useless through having been passed on to the British Museum, where they promptly “were mixed with other collections from Hudson’s Bay and Baffin’s Bay . . . it being impossible to separate them” (Sabine 1823:670). The second and most useful shipment of birds collected by Richardson was sent from Cumberland House in June 1820, soon after Richardson and Hood departed from there on 13 June 1820. Most of these specimens had been collected at or near Cumberland House, between November 1819 and June 1820, although a few were obtained during Richardson’s side-trip to Carlton House in May 1820 (Houston 1984:223-244). The third shipment of specimens was sent back to England via York Factory soon after Franklin’s party arrived on 25 July 1820 at Fort Resolution, which was then on Moose Deer Island near the southern shore of Great Slave Lake. Sabine also had seen at least a few of the watercolors of birds painted by Robert Hood prior to his tragic death on 20 October 1821. Surprisingly, Sabine also came into possession of Richardson specimens of Pied-billed (*Podilymbus podiceps*) and Red-necked Grebes (*Podiceps grisegena*) collected in May 1822 at Great Slave Lake; these should have reached Britain about the same time as Richardson did.

Sabine identified Cumberland House as the certain locality for five species and Carlton House on the edge of the plains for the Marbled Godwit (*Limosa fedoa*). Obviously, Richardson was not given an opportunity to add to the Sabine appendices on birds and mammals.

The main tragedy of Sabine's inappropriate intervention and authorship concerned the mixture of some successes and some lost opportunities. Sabine's 1823 appendix failed to mention 19 bird species painted by Hood, species seen or collected farther north and on the return journey, or species mentioned in Richardson's hand-written journal, the detailed bird descriptions from which remain unpublished (Houston 1984:223-244).¹ In his 1823 appendix, Sabine gave a Latin name to a new taxon, the Black-billed Magpie (*Pica hudsonia*), collected by Richardson and painted by Hood in November 1819 (plate 14 in Houston 1984). It was considered a subspecies in all seven American Ornithologists' Union (AOU) Check-lists, but has been a full species since the 42nd supplement (AOU 2000). Note that the magpie was labeled "hudsonian," not because it was near Hudson's Bay, but because it was collected within the vast territory administered by the Hudson's Bay Company (HBC) (Figure 3).²

A specimen from the Saskatchewan River, 21 June 1827, was named Wilson's Phalarope (*Phalaropus tricolor*) by Sabine (1823) to acknowledge the usefulness of Alexander Wilson's *American Ornithology* (1814). Sabine also noted in detail how a new gull differed from the Laughing Gull; it was not named *Larus franklinii*, Franklin's Gull, until 1832 by Richardson (plate 71 and pp. 424-425 in Swainson and Richardson 1832). The phalarope and gull persisted as "type specimens" in the Coues' *Check List* (1882) and the Third AOU *Check-list* (AOU 1910), respectively.³ Sabine described the distinguishing features of the as-yet-undescribed Semipalmated Plover (*Charadrius semipalmatus*), but gave it no Latin name, leaving the way open for Charles Lucien Bonaparte to describe and name it (Bonaparte 1827).

Near the expedition's winter quarters at Fort Enterprise, Richardson collected and wrote a careful description (reproduced in Houston 1984:225) of the first specimen of the Yellow-billed Loon (*Gavia adamsii*). Not only was this new loon omitted from Sabine, but Richardson inexplicably failed to mention it in his *Fauna Boreali-Americana* (1832). Had this description been published and a Latin name provided, in either 1823 or 1832, it would have been the type specimen.

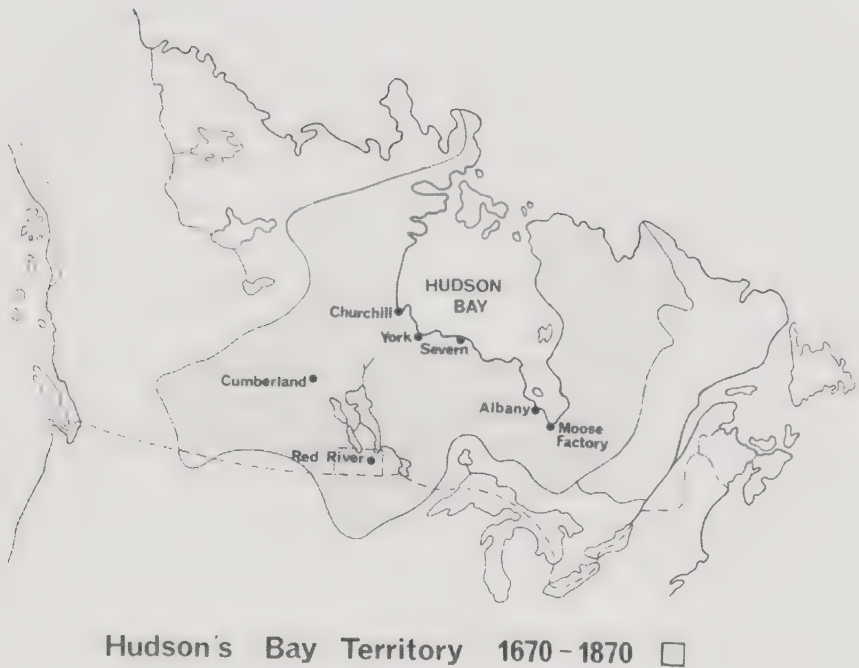


Figure 3. Map of Hudson's Bay Company Territory, 1670 - 1870. Map by Keith Bigelow, Geography Department, University of Saskatchewan. Reproduced with permission from Houston et al. 2003:11.

Richardson found the world's first recorded nest of the Eskimo Curlew (*Numenius borealis*) with three eggs, on the south shore of Point Lake on 13 June 1821 (Swainson and Richardson 1832:378; the year 1822 was an error). Hood painted an adult Eskimo Curlew at Fort Enterprise (plate 23 in Houston 1974), and three specimens were collected at York Factory (one on 26 July and two on 14 August 1822). The *only other ornithologist* with solid data about Eskimo Curlew breeding, with 33 clutches and five partial broods, was Roderick Ross MacFarlane, and his last was in 1866! (Gollop et al. 1986, Vaughan 1992:116). Richardson also found the first published Gyrfalcon (*Falco rusticolus*) nest in Canada, and almost certainly the first in North America, on the south shore of Point Lake in mid-June 1821 (Houston 1984:232).

In natural history classification, Richardson was ahead of his time, a "lumper" rather than a "splitter." When he described minor differences

from a similar species in Europe, he purposely did not ascribe a new Latin name to the form. The “Red-headed Wigeon,” now the Redhead (*Aythya americana*), collected at Great Slave Lake on 12 May 1822, he considered equivalent to the Common Pochard (*A. ferina*) in Europe. Similarly, the Lesser Scaup collected on the Saskatchewan River was similar to the [Greater] Scaup (*Aythya marila*) of Europe. It fell to Eyton (1838) to give these two scaup species new Latin names, *Aythya americana* and *A. affinis*, respectively. On 29 July 1822, Richardson collected an apparently new species of sandpiper, now known as the Stilt Sandpiper (*Calidris himantopus*) at York Factory and named it *Tringa hemipalma douglasii* in his diary/journal. By the time Richardson’s description and Swainson’s painting had been published in 1832, it was four to six years too late, Bonaparte having given this species the name, *Tringa himantopus*, in a presentation to the Lyceum of Natural History in New York on 24 January 1826, although it was not printed until 1828 according to Coues’ Bibliographical Appendix (1878:612). Canada’s first specimen of the Western Meadowlark (*Sturnella neglecta*) was collected at Carlton, 8 May 1827, but it fell to Audubon, during his trip up the Missouri River in May 1843, to recognize it as a new species from its entirely different song (plate 489 in Audubon 1844; 7:339-341).

During the winter of 1819-1820, Robert Hood, one of the Franklin expedition’s two artists, painted Richardson’s specimen of the new magpie (published as Plate 14 in Houston 1974), and four other full species not yet described for science, the Black-backed Woodpecker (*Picoides arcticus*), Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*), Hoary Redpoll (*Carduelis hornemanni*) (all three, Plate 13 in Houston 1974), and Evening Grosbeak (*Coccothraustes vespertinus*) (Plate 14 in Houston 1974). Hood’s painting (Cumberland House, 1819; Plate 16 in Houston 1974) and Richardson’s specimen (Great Slave Lake, 26 May 1822) of the Red-necked Grebe (*Podiceps grisegena*), may have been a first for Canada. These paintings were not published for a century and a half (Houston 1974) and the Yellow-headed Blackbird specimen apparently failed to reach England. Richardson also collected the first North American specimen of the Little Gull (*Larus minutus*, no locality given, but most probably near Cumberland House in 1819-1820) (Houston 1999:394-395).

Richardson’s initial scientific achievements are even more remarkable when viewed in the light of the difficulties encountered. During the summer of 1821 the first Franklin expedition surveyed and mapped for

the first time a portion of the arctic coastline of North America, 1040 km east from the mouth of the Coppermine River. Eleven of the 20 members of the Arctic exploring party died, most from starvation, on their tragic return trek across the Barren Lands (the tundra region south of Bathurst Inlet). During this trek, Richardson had to abandon his summer's collection of plant specimens after he had carried them "for many days through the snow" (Richardson et al. 1829:xiii). His heavy packet of pressed plants contained species which he knew had not yet been described to science, yet his notebook's detailed Latin descriptions of *Cardamine bellidifolia* and of *Stellaria humifusa* were sufficient without specimens to name and describe both in his revised botanical appendix (Richardson 1824:745, 754). Richardson and Franklin suffered from severe nutritional edema and were near death at Fort Enterprise when they were rescued by a party of Coppermine Indians on 7 November 1821.

Appendix to Parry's second arctic expedition.—Between the Franklin expeditions, Richardson spent the first winter helping Franklin prepare his *Narrative* for the press (Franklin 1823). He then prepared the account for the zoology of Parry's second voyage to the Arctic, 1821-1823 (most specimens were collected by John Edwards, Surgeon on the *Fury*; Richardson 1825). The most important new information in the Parry appendix concerned a previously undescribed gull collected by James Clark Ross at Igloolik, Melville Peninsula, on 2 July 1823, and described in considerable detail by Richardson as the "Cuneate-tailed Gull, *Larus Rossii*" at the January 1824 meeting of the Wernerian Natural History Society in Edinburgh. Richardson did not submit his talk for publication that month in the *Memoirs of the Wernerian Natural History Society*, because it was his duty to save his description and his new Latin name, *Larus Rossii*, for publication in the official appendix to Parry's journal. At the next (February 1824) meeting of the Wernerian Society, the assistant keeper of the Edinburgh museum, William MacGillivray (1824), in his introduction to his thirty-page review of gulls, reported in a casual, brief statement with no appreciable description, that "with regard to the tail there are two remarkable exceptions: the one the *Larus Sabinii*, the other *L. Roseus*, in which it is subcuneate, the middle feathers being considerably longer, the rest graduated." He added in a footnote "that this was a name he had given *pro tempore* to a new species of gull . . . which was to receive its proper designation

from Dr Richardson.” (Ralph 1993:63). Nearly two decades later, MacGillivray (1842) reminisced: “Dr Richardson named it *Larus rossii*, Cuneate-tailed Gull, which was its first true name, he having been commissioned to describe it.” (Ralph 1993:66). MacGillivray may, as Densley (1988:88-89) has said, “simply [have] wanted a temporary peg to hang it on so that he could discuss it. Nevertheless, under the strict rules of zoological nomenclature, . . . he had ‘published’ the species . . . and gave it a binomial name in print.”

Ironically, MacGillivray’s paper was written at the behest of Professor Robert Jameson at the University of Edinburgh, to remove confusion from the difficult topic of gull nomenclature. It did the very opposite. It had no headings for, and no full descriptions of, either Sabine’s (*Xema sabini*) or Ross’s (*Rhodostethia rosea*) gulls. MacGillivray described at length two supposedly “new” species of gulls, *Larus bathyrinchus*, the Great-billed Gull and *Larus glacialis*, the Greenland Gull, neither of which were new. He also suggested complete name changes, from Glaucous Gull (*Larus hyperboreus*) to Northern Gull (*Larus arcticus*) and from Herring Gull (*Larus argentatus*) to Silvery Gull (*Larus argenteus*). As well, he proposed changing the vernacular names of the Great Black-backed Gull (*Larus marinus*) to Carrion Gull and the Lesser Black-backed Gull (*Larus fuscus*) to Dusky Gull. In spite of these serious shortcomings which demonstrated his youthful ignorance of the then-nascent pre-Strickland principles of priority and type specimens, MacGillivray’s overly brief statement and Latin name were accepted for the Ross’s Gull.

Richardson mentioned the existence of two Ross’s Gull specimens collected on Melville Peninsula, one of which had been presented to Joseph Sabine in London. Richardson expressed his displeasure: “. . . it may be considered as peculiarly unfortunate that a bird of which only two examples have reached Europe, should already have been figured under two distinct appellations. . . . one ‘*pro tempore*’.” At least, Richardson’s vernacular name, Ross’s Gull, has persisted in use (Swainson and Richardson 1832:427).

The second Franklin expedition, 1825-1827.—Barely a year after returning from their nearly-totally-disastrous first expedition, Richardson and Franklin on 8 December 1823 began their joint planning for a second expedition to complete the survey of the Arctic coastline. While they waited, beginning in May 1824, Richardson was sur-

geon to the marine division at the large naval establishment at Chatham, east of London.

During the second Franklin expedition in 1825-1827, Richardson and his assistant Thomas Drummond collected and named seven new bird taxa: (1) White-tailed Ptarmigan (*Tetrao* [*Lagopus*] *leucurus*, now *Lagopus leucura*), was collected near present Jasper, Alberta, by Drummond, 1825-26 (plate 65 and p. 356 in Swainson and Richardson 1832). (2) Forster's Tern (*Sterna hirundo*), collected by Drummond, 18 July 1827, renamed *forsteri* by Nuttall because *hirundo* was preoccupied (Swainson and Richardson 1832:412). As a result of my historical researches into Thomas Drummond's whereabouts on 18 July 1827 (Houston and Street 1959:96-97), the type locality for Forster's Tern was changed from "banks of the Saskatchewan between Cumberland House and Lake Winnipeg" in the 5th AOU Check-list (1957:234) to "about 10-50 miles west of Cumberland House, Saskatchewan" in the 6th AOU Check-list (1983:232). (3) Black-backed Woodpecker (*Picoides arcticus*), was collected by Drummond near the headwaters of the Athabasca River, northeast of present Jasper, Alberta, latitude 54° (plate 57 and p. 313 in Swainson and Richardson 1832). The latitude for this woodpecker was given incorrectly as 57° in Swainson and Richardson 1832:313 and in the first six AOU Check-lists, but corrected through my input to the 7th Check-list (1998:xvi, 341). (4) Clay-colored Sparrow (*Emberiza pallida*, now *Spizella pallida*), was collected at Carlton by Richardson 14 May 1827 (Swainson and Richardson 1832:251-252). (5) Smith's Longspur (*Emberiza picta*, now *Calcarius pictus*), collected at Carlton by Richardson, April 1827 (plate 49 and p. 250 in Swainson and Richardson 1832). (6) Gray-crowned Rosy-Finch (*Linaria* [*Leucosticte*] *tephrocotis*, now *Leucosticte tephrocotis*), was collected at Carlton by Richardson in May 1827 (plate 50 and p. 265 in Swainson and Richardson 1832). (7) A new subspecies of towhee, now *Pipilo maculatus arcticus*, was described from a female collected on 29 May and a male on 1 July, both by Drummond at Carlton; both sexes were illustrated with full-page plates 51 and 52 painted by Swainson.

Two other new species, collected by others, were added: the Cackling Goose (*Anser hutchinsii*, now *Branta hutchinsii*), type specimen collected by John Edwards, surgeon on the *Fury*, on Melville Peninsula, 19 June 1822, during Captain William Edward Parry's Second Expedition (Swainson and Richardson 1832:470), and the

Trumpeter Swan (*Cygnus buccinator*), undated specimen from Hudson Bay (Swainson and Richardson 1832:464).

Richardson's May 1827 specimen of a Bonaparte's Gull (*Larus philadelphia*) from Great Bear Lake was considered the type specimen, until Baird (1858) communicated Ord's brief 1815 description under *Larus bonaparteii* (reprinted in Rhoads 1894:footnote, p. 319), but Richardson's vernacular name to honor Bonaparte has persisted. In Swainson and Richardson 1832, Richardson described one now recognized subspecies, *Larus canus brachyrhynchus* (p. 420) while Swainson named four: *Melanitta nigra americana* (p. 450-451), *Picoides pubescens medianus* (p. 307-308), *Lanius ludovicianus excubitorides* (p. 115-121), and *Pipilo maculatus arcticus* (plates 51, 52 and pp. 260-262). Swainson coined the new name *Orpheus meruloides* (Swainson and Richardson 1832:187-188) for the 1826 Great Bear Lake specimen of the Varied Thrush, now recognized as the type specimen for the subspecies, *Ixoreus naevius meruloides*. In 1845, Tschudi (1844-1846), in honor of Swainson, named the Swainson's Thrush *Catharus ustulatus*, but designated Richardson's specimen taken at Carlton, May 1827 as the type for the subspecies, *Catharus ustulatus swainsoni*.

Richardson was the sole author of *Fauna Boreali-Americana, Volume 1, The Mammals* (1829). Volumes 1 and 2 were the first zoological volumes published at the expense of the British government. For Volume 2, *The Birds*, Richardson wrote most of the useful information, including a fine 32-page introduction. In 1836, Richardson wrote *Volume 3, The Fish* and paid the printing costs. His collection of insects he gave to Rev. William Kirby, who then compiled *Volume 4, The Insects* (1837).

Not well known is the contact between the famous botanist and describer of new grouse species, David Douglas, and his fellow naturalists, Drummond and Richardson. Returning from his first visit to the Pacific coast in 1827, Douglas had visited with Drummond at Carlton House on 4-6 June and with Richardson at Cumberland House, 8-10 June. Douglas then accompanied Richardson and Franklin down the Saskatchewan River and Lake Winnipeg to reach Fort Alexander at the mouth of the Winnipeg River, from whence Franklin and Richardson continued on to Bytown (now Ottawa)⁴ and New York City en route to England. Douglas meanwhile visited at Fort Garry, the present site of Winnipeg, from 12 July to 10 August, then traversed Lake Winnipeg and the Hayes River to join the main expedition and the two remaining

Franklin expedition officers, George Back and E. N. Kendall, at York Factory (Douglas 1914). With Drummond, they embarked for Portsmouth, England, on the HBC ship, *Prince of Wales*, on 15 September, a few days after the three of them had a narrow escape from a hurricane when their rowboat was nearly completely swamped by heavy waves and blown a reported 100 km out into the bay. Following their near-deaths from hypothermia, they had a miserable month-long sailing voyage home, with Douglas confined to bed; he recovered full use of his limbs only after they reached *terra firma* in England (Drummond 1830:216-218).

William Swainson, whose only visit to the Americas was to Brazil in 1816-1818, began his collaboration with Richardson on 28 July 1828 (Houston 1988:559). Richardson thereby gained an experienced systematist and a pioneer lithographic artist as co-author. Swainson's color illustrations of 50 species of birds were of major importance, as were his smaller black-and-white sketches of the heads of birds, and his names and characterizations of 23 new genera that are accepted today.⁵ Less happily, Swainson also contributed an ill-advised and contrived attempt to force bird classification into the soon-discredited Quinary System of classification, which Richardson admitted he did not comprehend. Strickland (1845) pointed out that the quinary system was found "when tested by reason, to be improbable, and when by observation, to be untrue." Newton (1896:34) agreed, "The mischief caused by this theory of a Quinary System was very great." For an understanding of the doctrine and jargon of the Quinarians see Swainson's diagram reproduced in Walters (2003:120-121). Worse, Swainson's attempts to explain the quinary classification and relationships between each species, occupied 129 pages in the 501-page book, *The Birds*, and delayed its publication by nearly two years (Swainson and Richardson 1832).⁶ A footnote (Swainson and Richardson 1832:439) indicates that the Admiralty had imposed a limit on the book's size, preventing Swainson from printing his "very long dissertation on the natural groups" of the waterfowl, which would have resulted in more pages and more delay.

Richardson had intended that his name should appear as first author, as is evident from his letter to Swainson dated 5 December 1829 (Houston 1988:560) and on the title page of the proof sheets he shared with his esteemed former professor and mentor, Robert Jameson, during the first half of 1831. From Richardson's generous loan, accounts of 13

species from these proof sheets⁷ were reproduced in Jameson's European edition of Wilson and Bonaparte's *American Ornithology* (1831), which appeared in August that year (Browning and Monroe 1991). Yet, when he returned the final proofs to John Murray on 14 October 1831 (Houston 1988), Richardson magnanimously but inappropriately changed them to place Swainson's name ahead of his. As a result, the scientific literature in ornithology ever since has credited Swainson as the author of a number of genus names (*Chordeiles*, *Leucosticte*, *Scolecophagus*, and *Zonotrichia*),⁸ *Sylvicola* (an unaccepted subgenus of warblers set up to include the Yellow Warbler [*Dendroica petechia*]), and one species name (*leucurus* for the White-tailed Ptarmigan). The Richardson-Swainson correspondence transcribed by my wife, Mary, and myself, in the Linnean Society in London, demonstrates that the last six names were coined by Richardson (Houston 1988). He had obtained his superb knowledge of Latin at Edinburgh University, whereas Swainson had little or no Latin. Swainson received the credit because his name was attached when they first appeared in print. Swainson did, however, write the characters of each new genus. Most subsequent authors have overlooked Swainson's (1836:1:218) description of the collaboration between these men: "The whole of the descriptions, and nearly all the synonymes [sic], are entirely from the pen of Dr. Richardson; and we may, therefore, be permitted to express our opinion, in the words of another writer, that 'they are models of perfection.'"

As Gunther (1900) wrote: "Swainson was extremely careless in orthography and loose in his style of writing; he persistently misspelt not only technical terms, but also the names of foreign authors . . . he knew no modern language but his own, and the application of Latin and Greek for the purposes of systematic nomenclature was a constant source of error." Even though, apart from footnotes added on pages 433 and 457, Swainson's contributions ceased two-thirds of the way through compilation at page 342, this delay probably cost Richardson the priority for three species: the Double-crested Cormorant (*Phalacrocorax auritus*), Franklin's Gull (*Larus franklinii*), and Olive-sided Flycatcher (*Contopus cooperi*). These three species were later shown to have been described in 1831 by Lesson, Wagler, and Nuttall, respectively. Nevertheless, use of all three of these Latin names given by Richardson persisted until the third AOU Check-list in 1910, Oberholser in 1922, and Banks and Browning in 1995, respectively.

Five of the Franklin expedition's vernacular names persisted, even though the Latin names have been supplanted: Wilson's Phalarope, Franklin's Gull, Bonaparte's Gull, Ross's Gull, and Barrow's Goldeneye.⁹ In Europe the vernacular name of "Richardson's Skua" persisted for over a century, including Bannerman's volume 12 of *Birds of the British Isles* in 1963, before it changed to "Arctic Skua" [= Parasitic Jaeger, *Stercorarius parasiticus*] (Vaughan 1992:111).

Fitting with Hobsbawn's theory (1977) that 1830 was the beginning of a worldwide cultural revolution, 1831 seemed destined to be a banner year for major North American bird compendia. In addition to Nuttall's *Manual* (1831), they included Audubon's first volume of his *Ornithological Biography* (1831-1839), Lesson's two-volume work in French (1830-1831), Pallas's two-volume *Zoographia Rosso-Asiatica* (1831), a major paper by Wagler in *Isis von Oken* (1831), and Robert Jameson's four-volume, first European edition of Wilson and Bonaparte's *American Ornithology* (Jameson 1831). What should have been the sixth major work that year, *Fauna Boreali-Americana, Volume 2, The Birds*, was even further delayed by the bookbinding process at John Murray's and did not appear until 4 February 1832. This delayed publication date was first alluded to by T. Gill in a short-lived and somewhat obscure journal (Gill 1900). The date of 1832 was accepted by subsequent AOU checklists (beginning with AOU 1910) and was explained in greater detail by Browning and Monroe (1991). Nuttall's *Manual of Ornithology* was the reverse, for it had 1832 on its title page, yet appeared in print in Cambridge, Massachusetts, in December 1831 (Browning and Monroe 1991).

Two new species names first appeared in the above-mentioned Jameson edition in August 1831 and are so cited, although Richardson remains credited with their names: Trumpeter Swan (*Olor buccinator*); White-tailed Ptarmigan (*Lagopus leucurus*), and one new subspecies of the Mew Gull (*Larus canus brachyrhynchus*, type specimen, Great Bear Lake, 23 May 1826), although a first specimen had been collected at Fort Enterprise five years earlier.

Later authorities gave either Swainson's or Richardson's name to four taxa. (1) Richardson considered the Swainson's Hawk (*Buteo swainsoni*) to be similar to the European *Buteo vulgaris*. The day after Richardson left Carlton, on 22 May 1827, his assistant Thomas Drummond collected the first-ever specimen, illustrated by Swainson, and found the first two nests recorded of this new *Buteo*; eleven years

later Bonaparte, giving no description, appropriately named the species for Swainson (Bonaparte 1838). (2) Richardson recognized the Merlin (*Falco columbarius*) collected 14 May 1827 at Carlton House as different, but only in 1870 did Ridgway name this pale prairie race *Falco richardsonii* for Richardson (Ridgway 1870). (3) The North American subspecies of Boreal Owl (*Aegolius funereus*), again without a description, was named for Richardson by Bonaparte in 1838. The 4th AOU Check-list (1931) was the last in which English names were given to subspecies, in addition to the Latin name. Relegation of the Merlin and owl to the subspecies level thus resulted in the eponym, "Richardson's," being used much less often. (4) When Richardson gave a new name to an extremely pale Great Horned Owl from Carlton, Saskatchewan, he used the name *arcticus*, a name that later proved to be preoccupied due to an unfortunate, frivolous use by Forster of this name for a *Bubo* (Richmond 1902, Houston 1999), and hence *arcticus* was disallowed.

On 27 September 1831, after the specimens had been described, and proof sheets printed, Richardson turned over specimens of 102 species to the Zoological Society of London at that meeting; 23 species, and another 8 presented later, carried the notation "regarded by Dr. Richardson and Mr. Swainson as new to science" (Richardson 1831). All 31 species were listed in the 1831 Jameson edition of *American Ornithology* (1831, 4:244-245).¹⁰

There were ironies, coincidences, and delayed realizations. Drummond's American Dipper (*Cinclus mexicanus*) specimens, collected during his 13 months in the Rocky Mountains near Jasper, while the remainder of the Franklin party did their northern exploration, awaited publication until 1832. But the season after Drummond's departure, an employee of the HBC collected an American Dipper on the Athabasca River north of Jasper House in the Rocky Mountains (not Athabasca Lake as reported by Bonaparte in Jameson 1831, 4:93)¹¹ and sold it to Benjamin Leadbeater, a taxidermist and dealer in London England, where Bonaparte purchased it and named it that year (Bonaparte 1828). About the same time, John Peter Pruden, the HBC manager at Carlton, collected an Evening Grosbeak specimen and sent it to London in time for Swainson to illustrate it in plate 68 (Swainson and Richardson 1832).

One flycatcher taxonomist, Allan R. Phillips, recognized the May 1827 specimen from Carlton, (*Tyrannula pusilla*, plate 46, Swainson and Richardson 1832), as the unequivocal first description of the Least

Flycatcher (*Empidonax minimus*).¹² Rea (1983) and Todd (1963) agreed that the identification of the Carlton specimen was “unmistakeable.” Sadly, Swainson had also given the same name, *Empidonax pusillus*, to a Mexican flycatcher of uncertain species, which is deemed to have disqualified the Carlton bird from consideration as a possible type specimen (Banks and Browning 1995).

Richardson was the first to give a full description, including the black ring near the tip of its bill, of a normal Ring-billed Gull (*Larus delawarensis*). Yet Ord achieved priority for this species in an appendix to Guthrie’s *Geography* in 1815. Ord described the “Tooth-billed Gull” with an upper mandible with “four indentations of blunt teeth” and the lower mandible with three,” but Ord failed to mention the ring at the tip of its bill (Rhoads 1894:319 footnote, and Appendix p. 48). Baird (1858:847) considered this bill abnormality to be “a possible malformation or probably an accidental toothling, caused by its being worn.” This incomplete description, like MacGillivray’s description of the Ross’s Gull, had it come 51 years later, might well have been disqualified by Canon 36 of the fledgling American Ornithologists’ Union (1886:50) that “A name resting solely on an inadequate diagnosis is to be rejected.”

The lower bird portrayed in Plate 46 of Swainson and Richardson (1832) as *Tyrannula richardsonii*, and considered, incredibly, by both Baird (1858:189-190) and Coues (1874:247-249, though Coues said it was “very wrongly colored”), to be Richardson’s Wood-Pewee, was so listed by the first four American Ornithologists’ Union Check-lists. It was not until Allan R. Phillips and Kenneth C. Parkes (1955) explained that the painting (with the black bill, absent wing bars, and relatively short wings of an Eastern Phoebe, *Sayornis phoebe*), represented an error in identification by Baird. The Latin name of the Western Wood-Pewee thereby changed from *Contopus richardsonii* to *C. sordidulus*.

The second Franklin Arctic Land Expedition added two more species to the “Canadian” list. The first was the Mountain Bluebird (*Sialia currucoides*, a Richardson specimen from Great Bear Lake, with an erroneous date of “July 1825” [=1826]), accepted by the first and second AOU Check-lists (1886, 1895) as the type specimen, but was changed in the 3rd AOU Check-list, based on Richmond’s (1902) discovery of J. M. Bechstein’s painting from “virginien” [=western America] in Latham (1798). The second was the Bohemian Waxwing, with Drummond specimens from near Jasper, 1825-1826, and

Richardson's from Great Bear Lake, 24 May 1826, augmented by additional 1826 specimens from Jasper which were sold by HBC employees to the taxidermist, Mr. Benjamin Leadbeater in London, and then sold by him to Charles Lucien Bonaparte (Swainson and Richardson 1832:237-239).

There were apparent "firsts" in breeding records from the second Franklin expedition. The first published North American nest of the Great Gray Owl (*Strix nebulosa*) was encountered by Richardson at Great Bear Lake on 23 May 1826; the three young were raised as pets. Not only was Carlton House the type locality for a new subspecies of Loggerhead Shrike, *excubitorides*, but Drummond found its first Canadian nest, with six eggs, also at Carlton, in early June 1827.

Richardson's 1837 "Report on North American Zoology."—At the sixth annual meeting of the British Association for the Advancement of Science, Richardson presented his views on the similarities and differences between different clades of birds, world-wide. In his 102-page essay (Richardson 1837) he speaks of "recent refinements in the discernment of species." Perhaps only Bonaparte exceeded him in this insight.

Richardson's medical training led to some original observations. Consider his comparison of the Northern Hawk Owl to other owls, combining his field observations, "often met with in broad daylight," with anatomy, "auditory openings neither operculated or much exceeding those of other birds in size," concluding with "considerable analogy to the diurnal birds of prey." (Swainson and Richardson 1832:77, 92).

Stenhouse (1930) researched the collections of the Royal Scottish Museum and published a list of Richardson specimens then still extant, labeled and recognizable. These included types of four species, *Picoides arcticus*; *Lagopus leucurus*; *Larus franklinii*; *Larus philadelphia* (the latter two explained above), and one subspecies, now *Pipilo maculatus arcticus*. The Great Bear Lake specimen of the Bohemian Waxwing was also extant in 1930.

Richardson's survey and mapping career.—During the second Franklin expedition, Richardson, a competent naval geographer, mapped accurately most of the shoreline of Great Bear Lake, the fourth largest lake in North America. He and Lieutenant E. N. Kendall also mapped accurately the 1380 km of arctic coastline between the mouths

of the Mackenzie and Coppermine Rivers, the latter point being the most westerly mapped during the first expedition. Their maps were the standard until superseded by aerial surveys over a century later. This journey "put a roof on the map of Canada" (Neatby 1958:80). Richardson, Kendall, and the ten naval men confidently expected that their achievement of mapping the northern shore of North America from 135 to 114 degrees longitude, would have been more than sufficient to earn the parliamentary award for navigating and mapping Arctic seas extending across 15 meridians of longitude (Captain William Edward Parry and his men had shared £5000 for sailing west beyond 110 degrees of longitude to Melville Island in 1819). However, the government reneged on a technicality, saying that the £5000 prize was meant for sailing ships, not for rowboats with a mast and sail (Richardson 1852:138). Franklin in 1827 meanwhile fell short of the stipulated fifteen degrees of longitude when he mapped 600 km west of the Mackenzie, as far as Return Reef, falling 255 km short of meeting the barge sent east from Icy Cape by Captain Beechey's ship *The Blossom*. Perhaps it would have been awkward to reward the party under the second-in-command (Richardson) and not reward the leader (Franklin).

Richardson's medical career.—In 1828, Richardson was appointed chief medical officer of the new naval hospital built at Chatham and named for Viscount Melville, who had served as First Lord of the Admiralty during the great arctic expeditions of 1815-1830. Richardson "organized the hospital along efficient lines" and demanded that his staff provide good patient care. "He advocated airiness, dryness and cleanliness to control fevers. He worked very hard himself and demanded the same of all subordinates" (Johnson 1976:64).

In 1838, Richardson became the chief medical officer of the largest naval hospital in the world and the largest brick building in the British Empire — the Royal Naval Hospital Haslar near Gosport. He served in this capacity until his retirement in 1855. He raised the quality of nursing care in the navy, introduced humane treatment of mental disease in sailors, and introduced general anaesthesia into naval surgery. He demanded that every patient be seen by a surgeon before breakfast. He was an ally of Florence Nightingale in improving military nursing.

Arctic searching expedition, 1848-1849.—When John Franklin's third arctic exploring expedition, this time by sea, had not been heard

from for three years, Richardson felt duty-bound to lead a strenuous and well-organized search for his former chief. Neither age nor his memories of previous starvation deterred him. He enlisted as his assistant a fellow Edinburgh medical graduate, 34-year-old John Rae, an experienced, vigorous, tough arctic traveler who had spent his career with the HBC.

In 1848, Richardson and Rae left Montreal on 19 April and Sault Ste. Marie on 3 May, and in the fastest travel on record arrived at the mouth of the Mackenzie River on 3 August. They spent August searching the familiar coastline which Richardson had mapped during the second Franklin expedition. Although nearing his sixty-first birthday, and suffering some chest pain on exertion, Richardson kept up with the younger men on the fifteen-day overland march from the Coppermine River to Great Bear Lake. It was Rae who, on a later expedition of his own in 1853, first found incontrovertible evidence as to where Franklin and his 129 men had perished.

Richardson's achievements.—Richardson was a true generalist, proficient in surgery as well as natural history. During the first Franklin expedition, he described an increased prevalence of goiter among those living closer to the iodine-deficient mountain areas. He treated a North American Indian whose hand had been “dreadfully shattered by the bursting of his gun” the year before; by amputating above the wrist he restored the use of the arm. Richardson recorded that the Indian bore the operation without anaesthetic other than some liquor, “with an unchanging countenance.” On the second Franklin expedition, Richardson had another interesting surgical patient. Finan McDonald had been traveling downstream on the North Saskatchewan River, when he was badly gored by a buffalo bull. Botanist David Douglas bound up his wounds and gave him laudanum to allow sleep. McDonald was carried downstream on a six-day boat journey to Richardson at Cumberland House for more professional care that restored him to full duty.

Richardson's plants were made available to, and formed by far the largest portion of, William Jackson Hooker's still-quoted *Flora Boreali-Americana* (1840). Together with the mammals, birds, fish, and insects, catalogued in the four volumes of *Fauna Boreali-Americana*, these books provided a more complete pre-Caucasian-settlement inventory of natural history than is available anywhere else in North America. Richardson's writings allow us an understanding of the often over-

looked fact that, in the 1820s, large areas of the prairie were treeless as far north as the North Saskatchewan River at Carlton, due mainly to frequent prairies fires, combined with trampling by large herds of bison. Today, aspen parkland extends another 100 km farther south.

Richardson as a naturalist.—Richardson's medical and surgical training led him to dissect specimens, to identify which gonad was present, and to learn from stomach content what the bird had been eating. He had an historical bent. From the Hudson's Bay Company archives he learned a fact not available elsewhere: that about 80 years earlier, Alexander Light had been hired by the HBC "on account of his knowledge of Natural History." (Swainson and Richardson 1832:ix; Houston et al. 2003:34-40). Richardson also gained access to the hand-written accounts by surgeon Thomas Hutchins and fur-trader Andrew Graham, in the archives of the Royal Society and the Hudson's Bay Company, including Hutchins' early description of the behavior of the Yellow Rail (*Coturnicops noveboracensis*) (Swainson and Richardson 1832:402). Richardson also demonstrates his superb powers of observation and a great memory, in Table I, pp. xxii - xxxiii, in a time when birds in a new area were identified only after shooting them and "keying them out." Richardson made few errors in describing how far north each species was seen, suggesting that he had learned to identify many species by sight and behavior. Finally, his observations offer strong support for climate change over nearly two centuries; many species arrived up to a month later in the 1820s than they do today.

Richardson's later years.—In spare time from his medical practice, and after his retirement, Richardson edited zoological appendices for arctic voyages made by William Edward Parry (his second voyage, 1825), John Ross (his second voyage, 1835), George Back (1836), Frederick William Beechey (1839), James Clark Ross (1844), Edward Belcher (1848, 1855), and Henry Kellett (1854) (Johnson 1976:145-151). A world-renowned ichthyologist, Richardson analyzed collections from Australia and the China Seas, describing 43 genera and over 200 new species of fish.

Richardson was a key member of the Strickland Committee which achieved the "standardization of nomenclature." As Paul Farber said (1982:115), this "reform of nomenclature gave zoology, and ornithology in particular, a common language . . . and removed much unneces-

sary confusion.” These rules of zoological nomenclature and priority, building on the Linnaeus foundation, are still followed today. Ironically, the Strickland rules came too late to save Richardson’s priority for the Ross’s Gull and Ring-billed Gull, yet it was the very rules Richardson helped create that have given earlier priority to other naturalists for species originally credited to Richardson.

A member of the prestigious Arctic Council, Richardson advised the government in its search for the missing third Franklin expedition. For the eighth edition of the *Encyclopaedia Britannica* in 1853-1860, he wrote a 128-page article on ichthyology, a 21-page article on the polar regions, and a six-page biography of his old chief, John Franklin, who died during his ill-fated third expedition, along with all 129 officers and men.

Richardson was married three times and outlived two of his wives. He married Mary Stevens on 1 June 1818; she died without issue on 25 December 1831. When he was forty-five, he married Mary Booth on 8 February 1833. They had seven children, the five boys carrying names relating to the Franklin expeditions. John Franklin Richardson, Henry Hepburn Richardson, and Edward Kendall Richardson all died in childhood. John Booth Richardson became a major-general in the Royal Artillery. Willingham Franklin Richardson became a Captain in the Royal Engineers. Josephine Fanny Richardson died unmarried at age 20. Beatrice Anna Richardson married Charles Henry Reynolds and had seven children. Following the death of Mary Booth Richardson in 1845, Richardson married Mary Fletcher in 1847; he was 59 and she 43; she outlived him by 15 years.

Richardson was knighted in 1846, made Companion of the Bath in 1850, received the Royal Medal of the Royal Society of London in 1856, and an honorary LL.D. degree from Trinity College, Dublin, in 1857. He was recognized as one of Britain’s leading scientists. He attended, and sometimes presented papers at, the annual meetings of the British Association for the Advancement of Science. He retired in 1855 to a sumptuous home, Lancrigg, near Grasmere, in the lake country of England. Here his love of literature led to his final project. The Philological Society in 1857 enlisted him to compile a complete collection of the words used by his Dumfries friend, Robert Burns, together with their definitions in English and their cognates in Norse, Icelandic, and Gaelic. He did the same with Blind Harry’s *Wallace*, Gawain Douglas’s *Virgil*, and the Wycliffe *Book of Isaiah*. The entries, one per

word (eventually 3.5 million of them were submitted by 1300 readers), were collected by F. J. Furnivall and then sorted alphabetically in a "scriptorum" at Oxford University under James Augustus Henry Murray. The resulting first volume of the *New English Dictionary* (later revisions, still in print, are titled the *Oxford English Dictionary*), appeared in 1884 and the final, tenth volume, in 1924 (Murray 1977).

Richardson died at Lancrigg on 5 June 1865. He is buried near the poet William Wordsworth, who acted as his real estate agent when he purchased Lancrigg. His name is perpetuated in far northern Canada by a number of geographical features, the Richardson Mountains (in the Yukon), Richardson Islands (in Coronation Gulf), Richardson River (flowing into Coronation Gulf), Richardson Bay and Richardson Island in Great Bear Lake, Richardson Cape (on Adelaide Peninsula) and, much later, John Richardson Bay on Ellesmere Island (Canadian Board on Geographical Names 1958).

John Edward Gray, keeper of the zoological collections in the British Museum, said of Richardson: "The most strikingly distinguishing features in his character were his extreme caution in the verification of facts . . . and his untiring energy in the carrying out of whatever duties he undertook to perform. His caution originated in his entire devotion to truth . . ." (McIlraith 1868:275).

Richardson's modest acceptance speech in 1856 when he received the Royal Medal summarizes his life in his own words:

"I had to travel over a country reaching from the great American lakes to the islands of the Arctic Sea, and embracing more than the fourth of the distance from the equator to the pole, which had never before been visited by a professed naturalist. I perceived at once the magnitude of the field, and comprehended at a glance that it was far beyond my grasp. The only previous training I had was the little natural science that I had learned at my northern Alma Mater as a collateral branch of my medical education, but I thought that I could at least record what I saw: and I determined so to do as intelligently as I could and without exaggeration, hoping in this way to furnish facts on which the leaders of science might reason, and thus promote the progress of Natural History to the extent of my limited ability. This was the role I followed during the [nearly] eight years that I passed in those countries . . ." (Johnson 1976:106).

David Alexander Stewart, before the combined annual meetings of the British and Canadian medical associations in Winnipeg in 1930, conformed to Richardson's sense of innate modesty when he paid a slightly understated tribute to Richardson:

"Here is one who traversed our country in three laborious expeditions, lived nearly eight years in it, and spent a lifetime in working over its natural history. Plants of western Canada named by and for Richardson would make a garden of respectable size; and birds and animals named by and for him, a considerable zoo. He had in his life many of the conventional honours, and some special marks of distinction as well. His was, perhaps, a life of industry more than a life of genius, but it was a full, good life, and in many ways a great life. It is not every day that we meet in one person—surgeon, physician, sailor, soldier, administrator, explorer, naturalist, author and scholar, who has been eminent in some roles and commendable in all" (Houston and Street 1959:11).

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ENDNOTES

- ¹ Pacific Loon (*Gavia pacifica*, painted at Fort Enterprise by Hood); Yellow-billed Loon (*G. adamsii*, excellent description, Fort Enterprise, 1 Nov. 1820, but not published until Houston 1984:225); Rough-legged Hawk (*Buteo lagopus*, possibly North America's first recorded nest, 70 km sw of Fort Enterprise, 3 May 1821); Merlin (*Falco columbarius*, specimen, York Factory, 4 Sept. 1821=1822); Gyrfalcon (*Falco rusticolus*, probably North America's first recorded nest at Point Lake, mid-June 1821); Whooping Crane (*Grus americana*, description of specimen, no locality); Eskimo Curlew (*Numenius borealis*, world's first recorded nest, 3 eggs, Point Lake, 13 June 1821); Purple Sandpiper (*Calidris maritima*, specimen, York Factory, 29 July 1822); Stilt Sandpiper (*Calidris himantopus*, specimen, "new species," York Factory, 29 July 1822); Wilson's Snipe (*Gallinago gallinago*, specimen, Great Slave Lake, 15 May 1822); Mew Gull (specimen, new subspecies, *Larus canus brachyrhynchus*, Fort Enterprise, 22 May 1821, first named in Jameson 1831:352); Short-eared Owl (*Asio flammeus*, specimen, York Factory, 20 Aug. 1822); Black-backed Woodpecker (new species, now *Picoides arcticus*, painted by Hood at Cumberland House, 1820 and Jasper specimen painted by Swainson, plate 57, p. 313 in Swainson and Richardson 1832); Black-capped Chickadee (*Poecile atricapillus*, painted, Cumberland House, 1820); Boreal Chickadee (*Poecile hudsonica*, wintering, Fort Enterprise, 4 May 1821); Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*, painted, Cumberland House, "new species," 1820, named by Bonaparte in 1825); White-winged Crossbill (*Loxia leucoptera*, painted, Cumberland House, 1820); Hoary Redpoll (*Carduelis hornemanni*), painted, Cumberland House, 1820); and Evening Grosbeak

- (*Coccothraustes vespertinus*) painted, Cumberland House, "new species," 1820; named by W. Cooper in 1825).
- 2 Cumberland House was over 600 km from the bay. Carlton House, the type locality for the striped skunk, *Mephitis mephitis hudsonica*, was close to 1000 km from the bay.
 - 3 In 1884, it was realized that Wilson's Phalarope (*Phalaropus tricolor*) had been named from Paraguay by Vieillot (1819; 32:136). In 1920, Mathews and Iredale discovered that Franklin's Gull had been named *Larus pipixcan* by Wagler in May 1831 (Wagler 1831, Oberholser 1922, Houston 1999).
 - 4 Where John Franklin laid the first stone of the entrance locks to the Rideau Canal on 18 August 1827, since commemorated in the sesqui-centennial anniversary west window of Christ Church Cathedral, Ottawa.
 - 5 The native North American genera attributed to Swainson in the 7th AOU Check-list are (alphabetically): *Centrocercus*, *Chordeiles*, *Leucosticte*, *Melanerpes*, *Molothrus*, *Scaphidura*, *Selasphorus*, and *Zonotrichia*, plus *Leiothrix* which has been introduced to Hawaii. Swainson's proposed new genus, *Orpheus*, has not been accepted. *Scaphidura* was better described in Swainson's 1837 *Classification of Birds* (1837; 2:272) and at any rate was merged with *Molothrus* in the 42nd American Ornithologists' Union supplement, so on both counts can be deleted from this list.
 - 6 In the preface to *Birds*, 1832, p. lvii, Swainson said: "I feel that some apology is due . . . for the tardiness with which this Volume has followed the first. Whatever blame may be attached to this delay, must fall exclusively upon myself, as Dr. Richardson's portion has long been prepared. But my desire repeatedly to revise the groups, and submit their contents to many and diversified tests, not even alluded to in the subsequent details, has occupied no inconsiderable portion of two years; while impaired health, and the necessity of prosecuting literary engagements previously made, have all contributed to retard the publication."
 - 7 Long accounts were provided in Jameson's appendix for the following: California Condor (*Gymnogyps californianus*, Richardson in turn quoting from David Douglas), Golden Eagle (*Aquila chrysaetos*), Common Raven (*Corvus corax*), Cliff Swallow (*Petrochelidon pyrrhonota*), American Robin (*Turdus migratorius*), Ruby-throated Hummingbird (*Archilochus colubris*), Willow Ptarmigan (*Lagopus lagopus*), Rock Ptarmigan (*L. mutus*), White-tailed Ptarmigan, Trumpeter Swan, Mew Gull, and Franklin's Gull. From Richardson's 1825 appendix to Parry's Voyage were added the Snow Bunting (*Plectrophenax nivalis*), the "Great Northern Diver"—a meld of at least two loon species—and waterfowl migration.
 - 8 *Scolecophagus* was the genus for the Rusty (now *Euphagus carolinus*) and Brewer's Blackbirds (*E. cyanocephalus*) until changed to

Euphagus in the 3rd AOU Check-list (1910).

- ⁹ In the case of the Barrow's Goldeneye, Gmelin had received a specimen from Iceland and hence had named it [*Bucephala*] *islandica* in 1789.
- ¹⁰ The Veery, now *Catharus fuscescens*, had already been named by Stephens (1817, see Rhoads 1894:38) and the Hermit Thrush, *Catharus guttatus*, by Pallas (1811). The Red-shafted Flicker, now *Colaptes auratus cafer*, and the Rufous Hummingbird, *Selasphorus rufus*, had both been described by Gmelin (1788). The newly-named *Garrulus brachyrhynchus* proved to be merely the young of the Gray Jay (Baird 1858:590).
- ¹¹ The 4th AOU Check-list in 1931, the first to give detailed type localities, noted Bonaparte's error of 750-plus km between the Jasper area at the headwaters of the Athabasca River and Athabasca Lake, much farther north.
- ¹² Hence Phillips used the name, *Empidonax pusillus*, for the Least Flycatcher in *Birds of Arizona* (Phillips et al. 1964).

LITERATURE CITED

- Acharius, E. 1810. *Lichenographia Universalis*. I. F. Danckwerts, Gottingen, Germany.
- American Ornithologists' Union. 1886. The code of nomenclature and check-list of North American birds. American Ornithologists' Union, New York.
- American Ornithologists' Union. 1895. Check-list of North American birds. Second edition. American Ornithologists' Union, New York.
- American Ornithologists' Union. 1910. Check-list of North American birds. Third edition. American Ornithologists' Union, New York.
- American Ornithologists' Union. 1931. Check-list of North American birds. Fourth edition. American Ornithologists' Union, Lancaster, Pennsylvania.
- American Ornithologists' Union. 1957. Check-list of North American birds. Fifth edition. American Ornithologists' Union, Baltimore, Maryland.
- American Ornithologists' Union. 1983. Check-list of North American birds. Sixth edition. American Ornithologists' Union, Washington, D.C.
- American Ornithologists' Union. 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, D.C.
- American Ornithologists' Union. 2000. Forty-second supplement to the AOU Check-list of North American birds. *Auk* 117:847-858.
- Anonymous. 1866. Sir John Richardson. *American Journal of Science* (2nd series) 41:265.
- Audubon, J. J. 1831-1839. *Ornithological biography*. Adam Black, Edinburgh.
- Audubon, J. J. 1844. *Birds of America*. Volume 7. J. J. Audubon, New York.
- Baird, S. F. 1858. Reports of explorations and surveys from the Mississippi River to the Pacific Ocean. Volume 9. Birds. Washington, D. C.
- Banks, R. C., and M. R. Browning. 1995. Comments on the status of revived

- old names for some North American birds. *Auk* 112:633-648.
- Bonaparte, C. L. 1827. Observations on the nomenclature of Wilson's Ornithology. *Journal of the Academy of Natural Sciences (Philadelphia)* 5:95-106.
- Bonaparte, C. L. 1828. Die sippen der nordamericanischen vogel und eine synopsis der gattungen in den vereinigten staaten. *Annals of the Lyceum of Natural History of New York*. 2:
- Bonaparte, C. L. 1838. A geographical and comparative list of the birds of Europe and North America. John Van Voorst, London.
- Boulger, G. S., and A. Goldbloom. 2004. Joseph Sabine (1770-1837). *Oxford Dictionary of National Biography*. [<http://www.oxforddnb.com/view/article/24438>, accessed 31 March 2009].
- Browning, M. R., and B. L. Monroe, Jr. 1991. Clarifications and corrections of the dates of issue of some publications containing descriptions of North American birds. *Archives of Natural History* 18:381-405.
- Canadian Board on Geographical Names. 1958. *Gazetteer of Canada: Northwest Territories and Yukon*.
- Coues, E. 1874. *Birds of the Northwest*. Government printing office, Washington, D.C.
- Coues, E. 1878. Bibliographical appendix. Pp. 567-784 in E. Coues, *Birds of the Colorado Valley*. Government Printing Office, Washington, D.C.
- Coues, E. 1882. The Coues check list of North American birds. Estes and Lauriat, Boston.
- Densley, M. 1988. James Clark Ross and Ross's Gull: a review. *Naturalist (Leeds)* 113:85-102.
- Douglas, D. 1914. Journal kept by David Douglas during his travels in North America, 1823-1827. William Wesley & Son, London.
- Drummond, T. 1830. Sketch of a journey to the Rocky Mountains and to the Columbia River in North America. *Botanical Miscellany* 1:178-219.
- Eyton, T. C. 1838. A monograph on the Anatidae, or duck tribe. Longman, Orme, Brown, Green & Longman, London.
- Farber, P. L. 1982. The emergence of ornithology as a scientific discipline: 1760-1850. D. Riedel, Dordrecht, Netherlands.
- Franklin, J. 1823. Narrative of a journey to the shores of the polar sea in the years 1819, 20, 21 and 22. John Murray, London.
- Gill, T. 1901. William Swainson and his times. Parts 7, 8, 9. *Osprey* 5:37-39, 58-59, 71-72.
- Gmelin, J. F. 1788-1789. *Systema Naturae*, 13th edition. Lipsiae [Leipzig]. Germany.
- Gollop, J. B., T. W. Barry, and E. H. Iversen. 1986. Eskimo Curlew: a vanishing species? Saskatchewan Natural History Society Special Publication no. 17.
- Gunther, A. C. L. G. 1900. Presidential address: The unpublished correspondence of William Swainson with contemporary naturalists (1806-1840). *Proceedings of the Linnean Society of London* 112:14-61.
- Guthrie, W. 1815. A universal geography. Benjamin Warner, Philadelphia. [see Rhoads 1892].
- Hobsbawn, E. J. 1977. The age of revolution: Europe, 1789-1848. Abacus, London.
- Hooker, W. J. 1840. *Flora Boreali-Americana*. Henry G. Bohn, London.

- Houston, C. S. (ed.). 1974. To the arctic by canoe: the journal and paintings of Robert Hood. McGill-Queen's University Press, Montreal.
- Houston, C. S. (ed.). 1984. Appendix A: Bird observations by John Richardson during the first Franklin expedition. Pp. 223-244 in *Arctic Ordeal: The Journal of John Richardson, surgeon-naturalist with Franklin, 1820-1822*. McGill-Queen's University Press, Montreal, Quebec.
- Houston, C. S. 1988. John Richardson: deserving of greater recognition. *Canadian Field-Naturalist* 102:558-563.
- Houston, C. S. (ed.). 1994. Arctic artist: The journal and paintings of George Back, midshipman with Franklin, 1819-1822. McGill-Queen's University Press, Montreal.
- Houston, C. S. 1999. Appendix: list of new species added to North American natural history, 1825-1827, by surgeon-naturalist John Richardson. Pp. 391-400 in R. C. Davis, ed., *Sir John Franklin's Journals and Correspondence: The Second Arctic Land Expedition*. Champlain Society, Toronto.
- Houston, C. S., and M. G. Street. 1959. Birds of the Saskatchewan River, Carlton to Cumberland. Saskatchewan Natural History Society, Regina.
- Houston, S., T. Ball, and M. Houston. 2003. Eighteenth-century naturalists of Hudson Bay. McGill-Queen's University Press, Montreal.
- Hume, E. E. 1942. Ornithologists of the United States Army medical corps. Johns Hopkins Press, Baltimore.
- Jameson, R. (ed.). 1831. American ornithology, or the natural history of the birds of the United States, by Alexander Wilson and C. L. Bonaparte. Volumes 1-4. Constable, Edinburgh.
- Johnson, R. E. 1976. Sir John Richardson: arctic explorer, natural historian, naval surgeon. Taylor and Francis, London.
- Kirby, W. 1837. Fauna Boreali-Americana; or The zoology of the northern parts of British America. Part 4. The insects. Josiah Fletcher, Norwich, England.
- Latham, J. 1798. Allgemeine Uebersetzung Vögel 3, ii: 546, plate 121.
- Lesson, R. P. 1831. *Traité d'ornithologie ou description des oiseaux réunis dans les principales collections de France* 8:605. Levrault, Paris.
- Lloyd, C., and J. L. S. Coulter. 1963. Medicine and the Navy. Volume 4: 1815-1900. E. and S. Livingstone, Edinburgh.
- MacGillivray, W. 1824. Descriptions, characters, and synonyms of the different species of the genus *Larus*, with critical and explanatory remarks. *Memoirs of the Wernerian Natural History Society* 5:247-276.
- MacGillivray, W. 1842. A manual of British ornithology. Part II. The water birds. Webster and Geary, London.
- Mathews, G. M., and T. Iredale. 1921. Notes of interest. *Australasian Avian Record* 4:155-156.
- McIlraith, J. 1868. Life of Sir John Richardson. Longmans, Green, and Co., London.
- Mearns, B., and R. Mearns. 1988. Biographies of birdwatchers: the lives of those commemorated in western Palearctic bird names. Academic Press, London.
- Mearns, B., and R. Mearns. 1992. Audubon to Xántus: the lives of those commemorated in North American bird names. Academic Press, London.
- Murray, K. M. E. 1977. Caught in the web of words: James A. H. Murray and

- the Oxford English Dictionary. Yale University Press, New Haven, Connecticut.
- Neatby, L. H. 1958. In quest of the North West Passage. Longmans, Green, and Company, Toronto, Ontario.
- Newton, A. 1896. A dictionary of birds. Adam and Charles Black, London.
- Nuttall, T. 1831, 1840. A manual of the ornithology of the United States and Canada. Hilliard, Gray and Company, Boston.
- Oberholser, H. C. 1922. Seventh annual list of proposed changes in the A.O.U. Check-list of North American Birds. *Auk* 39:243-249.
- Pallas, P. S. 1831. *Zoographia Rosso-Asiatica, sistens omnium animalium in extenso Imperio Rossico et adjacentibus maribus observatorum recensionem, domicilia, mores et descriptiones, anatomen atque icones plurimorum*. Volumes 1 and 2. Academie Scientiarum Impress, St. Petersburg, Russia.
- Pearse, T. 1968. Birds of the early explorers in the northern Pacific. Gray's Publishing, Comox, British Columbia.
- Phillips, A. R., J. Marshall, and G. Monson. 1964. The birds of Arizona. University of Arizona Press, Tucson.
- Phillips, A. R., and K. C. Parkes. 1955. Taxonomic comments on the Western Wood Pewee. *Condor* 57:244-246.
- Ralph, R. 1993. William MacGillivray. HMSO, London.
- Rea, A. M. 1983. Once a river: bird life and habitat changes on the Middle Gila. University of Arizona Press, Tucson.
- Rhoads, S. N. 1894. A reprint of the *North American Zoology*, by George Ord. Being an exact reproduction of the part originally compiled by Mr. Ord for Johnson & Warner, and first published by them in their Second American Edition of Guthrie's Geography, in 1815. Samuel N. Rhoads, Haddonfield, New Jersey.
- Richardson, J. 1823. Botanical appendix (VII). Pp. 729-763 in J. Franklin, Narrative of a Journey to the Shores of the Polar Sea in the Years 1819, 20, 21 and 22. John Murray, London.
- Richardson, J. 1824. Botanical appendix (VII, expanded and revised). Pp. 729-783 in J. Franklin, Narrative of a Journey to the Shores of the Polar Sea in the Years 1819, 20, 21 and 22. John Murray, London.
- Richardson, J. 1825. Appendix to Captain Parry's journal of a second voyage. Zoological appendix no. 1. Account of the quadrupeds and birds. John Murray, London.
- Richardson, J. 1831. An extensive collection of skins of birds from the northern regions of North America. Proceedings of the Committee of Science and Correspondence of the Zoological Society of London 1:132.
- Richardson, J., [W. Swainson, and W. Kirby]. 1829. *Fauna Boreali-Americana; or, The zoology of the northern parts of British America*. Part first, containing the quadrupeds. John Murray, London.
- Richardson, J. 1836. *Fauna Boreali-Americana; or The zoology of the northern parts of British America*. Part third: The fish. Richard Bentley, London.
- Richardson, J. 1837. Report on North American zoology. British Association for the Advancement of Science 6:121-224.
- Richardson, J. 1852. Arctic searching expedition. Harper and Brothers, New York.
- Richmond, C. W. 1902. The proper name for the Arctic Horned Owl.

- Proceedings of the Biological Society of Washington 15:86.
- Ridgway, R. 1870. A new classification of the North American Falconidae with descriptions of three new species. *Proceedings of the Academy of Natural Sciences of Philadelphia* 22:138-150.
- Sabine, J. 1822. Account of the marmots of North America, with notices and descriptions of three new species. *Transactions of the Linnean Society* 13:579-591.
- Sabine, J. 1823. Zoological appendix. V. Birds. Pp. 669-703 in J. Franklin, *Narrative of a Journey to the Shores of the Polar Sea in the Years 1819, 20, 21 and 22*. John Murray, London.
- Stenhouse, J. H. 1930. Birds of historic interest in the Royal Scottish Museum. III. Birds of Franklin's overland expeditions. *Scottish Naturalist* 1930:75-84.
- Stephens, J. F. 1817. Shaw's *General Zoology*. Volume 10, Aves. London [publisher unknown].
- Stresemann, E. 1975. *Ornithology from Aristotle to the present*. Harvard University Press, Cambridge, Massachusetts.
- Strickland, H. E. 1845. Report on the recent progress and present state of ornithology. Report of the Fourteenth Meeting [1844] of the British Association for the Advancement of Science, p. 173.
- Swainson, W. 1836. On the natural history and classification of birds. Vols 1 and 2, *Cabinet Cyclopaedia*. Longman, Hees, Orme, Brown, Green and Longmans, London.
- Swainson, W., and J. Richardson. 1832. *Fauna Boreali-Americana; or, The zoology of the northern parts of British America: Part second, the birds*. John Murray, London.
- Thomson, J. W. 1984. Appendix E. John Richardson's contribution to lichenology: solution of a 160-year-old puzzle. Pp. 270-272 in C. S. Houston, *Arctic Ordeal*, McGill-Queen's University Press, Montreal.
- Todd, W. E. C. 1963. *Birds of the Labrador Peninsula and adjacent areas*. University of Toronto Press, Toronto.
- Tschudi, J. J. von. 1844-1846. *Fauna Peruana, Aves*. Schleiten and Zollikofer, Berlin.
- Vaughan, R. 1992. *In search of Arctic birds*. T & AD Poyser, London.
- Vieillot, L. P. 1819. *Nouveaux Dictionnaire d'Histoire Naturelle*, nouveaux ed. 32:136. Paris.
- Wagler, J. 1831. Einige mittheilungen über Thiere Mexicos. *Isis von Oken* 24(5):col. 515.
- Walters, M. 2003. *A concise history of ornithology*. Yale University Press, New Haven.
- Wilson, A. 1814. *American ornithology*. Bradford and Inskeep, Philadelphia.

Early Saskatchewan Bird Banders

*C. Stuart Houston*¹

ABSTRACT.—Residents of the largely agrarian inland province of Saskatchewan obtained a disproportionate number of the early banding permits issued to Canadians during the first 34 years of banding. This fact, together with the unusual completeness of the records available for Saskatchewan bird banding between 1921 and 1954, led me to review the available data. The total of 109,774 individual birds banded, with 6845 recoveries, was roughly twice the number of birds banded per capita, as compared to the average for the rest of North America. Anyone in rural Canada, far from any ornithologist who could vouch for them, was promptly issued bands if that person chose to apply for a bird-banding permit.

Review of these records reveals the number of birds banded, documents unusual occurrences, identifies a few exceptional recovery rates, longevity, and distance records, and contributes to our understanding of natal dispersal, behavior, ecology, and population dynamics. The early bander's main reward for altruistic curiosity and sense of adventure was to learn first-hand about migration pathways.

Through this review I explore the work of Saskatchewan's voluntary bird banders during the first three decades of organized banding, assess their occupations and possible motives, and share the excitement of the new and sometimes unexpected knowledge they gained about migration pathways. I also explore possible reasons for the high recovery rates (and hence reporting rates) during the first 30 years of banding. Place names not followed with a state or province abbreviation are all within Saskatchewan (Figure 1).

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METHODS

Before I proceed, I will explain (a) terminology and (b) some aspects of the history of storage of North American banding records.

Banding terminology.—As with any innovation, bird-banding terminology has changed over time. A *return* initially meant any subsequent report of a banded bird, until Gillespie (1930) suggested that “return” be restricted to a bird returning to the place of banding in a subsequent season. *Recovery* refers to a bird “killed or found dead and reported to the bird banding offices” (Environment Canada 1991). *Encounter*, simply “an observation of a previously banded bird” (Environment Canada 1991) is now the preferred term for a bird encountered dead or alive; the term is necessary because in recent years more and more birds are captured alive (often in mist nets or banding traps) and released unharmed.

Sources, quality, and history of data.—This study is an assessment of the work of 74 banders working under 69 banding permits (two people at one address shared the same permit number on five occasions), active between 1921 and 1954 (Table 1). There were no subpermittees. For the few banders who continued for one to four years beyond the 1955 cutoff, I included those years in compiling their life totals.

Early personal contact with banders and banders’ families, beginning in the 1940s, was my first and most reliable source of information. In the 1940s and 1950s, I obtained carbon copies of the complete long-term banding records kept by Fred G. Bard and borrowed the data resulting from 11 permittees: John R. Carter, R. H. Carter, Jr., Stuart Francis, Hartley Fredeen, Don and Ron Hooper, George Lang, Reuben and Bert Lloyd, Maurice G. Street, Billy Matthews, Arthur Ward, and Lindsay and Bill Wotherspoon.

Completion of my list of Saskatchewan banders during 1921–1954 (Table 1) was made possible by two visits to the U.S. Bird Banding Laboratory (BBL) on the Patuxent Wildlife Research Center at Laurel, Maryland, in January and April 1990. With assistance from my wife, Mary, we photocopied individual cards which listed the first 929 banding permit numbers issued in North America. Of the first 557 banders in Canada, 16 were also issued a different low number permit (of 929 or less). Of 301 banders in

Table 1. Early Saskatchewan Bird Banders. "Locality" indicates where the bander lived/worked. "USGMA" refers to "U. S. Game Management Agent." The letters in the first column indicate the the source of the data (see note at end of table).

	Permit	Name of bander	Locality	Years banding	# indiv	# spec	# recov
P	05537	Albulet, Nicholas/ Hamel, F.	Regina	1934-36	27	2	0
P	00299	Atkinson, E.A.	Wapashoe	1927-34	94	20	0
O	00151	Bard, Fred G.	Regina & Last Mtn	1928-62	13364	104	1323
P	00006	Baynton, Edgar E.	Bigstick Lake	1923-34	172	24	2
P	00443	Bird, Dick	"Avonlea, Regina"	1941-49	91	21	4
P	00164	Blakeley, Robert M.	Tadmore	1929-30	90	20	2
P	00002	Bradshaw, Fred	Regina & various	1921-32	69	8	5
P	00033	Briggs, J.A.	Regina & various	1925-48	1076	24	19
VP	07294	Buller, R.J.	USGMA	1954	1343	10	141
VI	00342	Carter, Edward T	USA	1937	16	1	5
O	00016	Carter, John R.	Muscow	1929-52	1739	61	26
O	00023	Carter, R.H., Jr.	Muscow	1923-61	5240	70	60
VI	00579	Colls, D.G.	Manitoba	1951	8	2	5
P	00034	Dick, John J.	Elstow	1929	28	7	3
P	00181	Etter, A.E.	Regina	1932	18	2	3
P	00007	Felt, Harry L.	Findlater	1922-31	47	8	3
O	00709	Francis, Stuart J & C Stuart	Torch River	1954-59	1690	35	18
O	00369	Fredeen, F.J. Hartley	Macrorie	1938-43	1764	74	47
P	06143	Furniss, O.C.	Prince Albert	1932-33	39	5	0
P	00356	Gold, John R.	Maple Creek	1935-37	62	10	1
*P	00592	Gollop, J. Bernard	"CWS, Saskatoon"	1952-54	4284	13	531
P	00215	Goosen, H.D.	Dalmeny	1934-39	217	22	0
VI	00036	Gresham, A. Burt	Winnipeg	1939	??	1	3
P	00237	Hammond, W.F.	Cupar	1932-42	254	13	14
P	00238	Harper, Thomas A.	Simpson	1933-40	418	29	12
V*P	06806	Hayes, Charles R.	USGMA	1954-56	5068	10	510
P	00362	Hedlin, Ralph & Alan	Renown	1938-39	430	24	7
P	00180	Holmes, Charles F.	Dollard	1928-44	56	14	7
O	00723	Hooper, Don & Ron	Somme	1954-56	177	26	0
*O	00460	Houston, C. Stuart	Yorkton	1943-2009	6712	92	748
P	00807	Isinger, Brian	"Big River, Yellow Cr."	1954-56	11	2	0
P	none	Knowles, E.H.M.	Regina	1934	15	6	0
V*P	07714	Kriebble, Don W.	USGMA	1954-55	1068	8	129
O	00054	Lang, George	Indian Head	1923-39	6313	55	60
P	00245	Lavallee, Edmund	"Cupar, Dysart"	1932-39	3	2	1

VI	00039	Lewis, Harrison F.	"Ottawa, Prince Albert"	1948	12	1	2
O	00014	Lloyd, Reuben, Bert	Davidson	1923-37	3177	73	406
P	00357	Loewen, Abe S.	Hepburn	1936-38	166	20	2
VI	04071	Low, Seth H.	Patuxent	1954	70	4	8
VP	06706	Lynch, John J.	"Washington, D.C."	1949	3733	10	428
VP	00435	Lyon, William I.	"Illinois, USA"	1936-37	1138	13	59
NP	00733	MacFarlane, J.D.B.	Waskesiu	1951-56	223	1	52
V	none	Martin, A.W.	"Kinistino, Findlater"	1921	445	8	
O	00540	Matthews, Bill	Nipawin	1950-58	11296	96	19
VI	04585	McArthur, H.E.	"Illinois, USA"	1936-37	244	11	16
VP	00615	McClanahan, Robert C.	"Washington, DC"	1940-41	138	3	2
P	00477	McPherson, Arnold	Saskatoon	1946-52	1288	39	46
P	00294	Mowat, Farley	Saskatoon	1935-37	256	18	1
P	00344	Myers, Homer	Rabbit Lake	1937-39	245	22	3
P	00021	Patrick, J.A.M.	Yorkton	1926-33	2060	17	175
P	none	Potter, Laurence B.	Eastend	1929	3	1	0
VI	04241	Ransom, Webb H.	USA	1936	18	5	2
VI	03305	Saunders, G.B.	"Washington, D.C."	1938	31	3	3
P	00022	Siemens, Philip	Hepburn	1928-37	416	32	9
P	00008	Silver, James	Unity	1922	7	4	4
P	00467	Simard, Arthel	Cabri	1938-39	70	16	6
VP	06709	Stoudt, Jerome J.	USGMA	1952-54	487	8	116
O	00520	Street, Maurice G.	Nipawin	1945-60	14228	106	34
NI	00583	Strong, B.I.M.	Waskesiu	1951	25	1	6
VP	06503	Thompson, Floyd	"Washington, D.C."	1950-53	7318	10	956
VP	07653	Tice, Rex C.	USGMA	1954-54	1891	7	206
VI	05498	Todd, H.O.	Woodrow	1947-49	80?	1	8
O	00426	Ward, Arthur	Burnham	1939-57	2820	88	5
P	00285	Wickencamp, Mrs. F.	Stenen	1933-39	207	28	9
P	none	Willers, Mrs. T.	"Viceroy, Wolseley"	1927-31	188	30	0
P	00318	Willett, R.C.	Cochin	1937-39	186	17	3
VP	00500	Williams, Cecil S.	"Washington, D.C."	1947-48	5449	11	569
VI	03281	Williams, Roland	Wisconsin	1926	2	1	1
O	00190	Wotherspoon, Bill,	Hyas	1931-41	885	40	20
		Lindsay					
		TOTAL			109840		6845

I - by inference from computerized summaries of bandings and computerized lists of recoveries; N - National Park; O - original records; P - photocopies of schedules; V - visitor to Sask.;

* - continued banding in 1955 and beyond, but totals beyond 1954 are not included

the U.S., 8 received a duplicate low number; and 28 were from 16 jurisdictions outside the U. S. and Canada.

By the time punch coding began in 1929, active Canadian banders had been assigned a permit number. United States banders had been

given permit numbers 1001 and up, beginning in 1921, but most received numbers above 2001 (C. S. Robbins, pers. comm.). The first thousand numbers were designated primarily for Canadians (Houston 1990b). Some of the low-number permits were issued to American state or federal Game Management Agents who came to band ducks in Canada and others such as H. C. Hanson, who banded geese in the Perry River region of the Canadian Arctic. Saskatchewan banders received 4 of the first 10, and 11 of the first 40 permit numbers (Houston 1990a) – figures of over 25%, disproportionate to the rest of Canada.

While at the BBL, we also copied many original Saskatchewan schedules that had been prepared by 36 banders. From these we made a list of the number of individuals of each species banded each year by each bander. During our visits, we found that occasional files for certain species were missing, for example, schedules for the Common Terns (*Sterna hirundo*) banded by J. A. M. Patrick could not be located. At the time of our visits, some recovery reports and correspondence concerning non-game birds were kept in filing cabinets in an unheated garage down the hill, many drawers of which had already been destroyed by moisture and frost and some by decay of paper. Occasional lower drawers of cabinets had been invaded by mice, some of which shredded this correspondence and nested therein.

Schedules preserved on microfilm were neither as accessible nor durable as had been planned; in 1990 the microfilm readers and printers were barely functional, and ten years later were no longer functioning. Purchase of a microfilm scanner in 2007, and the presence of original untouched microfilm reels in storage, once again allows ability to locate original documents and verify records.

With verification processes in place and corrections made when errors were detected, keypunching maintained a satisfactory standard of excellence. As with any system of transference of data, a few errors crept in. Keypunching required that all localities retrospectively be assigned a ten-minute degree block of latitude and longitude; here, a few errors were inevitable. For example, when Reuben Lloyd traveled 50 km east to band colonial birds near Imperial on Last Mountain Lake, most were assigned the “home base” ten-minute block of 51° 20' N, 105° 50' W, for the town of Davidson, not 51° 20' N, 105° 10' W, for Imperial Beach. This error on 1965 printouts has since been corrected.

Encounters/Recoveries.—In 1965, the Canadian Bird Banding Office (BBO) provided me a print-out of all non-game band recoveries for Saskatchewan. This allowed corroboration of our data excerpted from the banders' files, as did publication of "Official Canadian record of bird-banding returns" in 36 installments within selected issues of *Canadian Field-Naturalist* (Canadian National Parks Branch, May 1924 to March 1932). Lincoln (1924, 1927) published nearly-complete lists of recoveries obtained through 1926, supplemented by lists of waterfowl recoveries with a separate map of waterfowl recoveries of birds banded in Saskatchewan (Lincoln 1933a), and of raptor recoveries (Lincoln 1936). His final list of banding records of unusual interest includes 11 individual Saskatchewan birds banded by 9 banders (Lincoln 1939b). May Thacher Cooke, in ten installments in *Bird-Banding*, 1936-1943, published additional records of special interest.

Not all valid recoveries were transferred into the computerized system. For example, only 55 of Reuben Lloyd's 62 Double-crested Cormorant (*Phalacrocorax auritus*) recoveries are present in the computer recovery printout, but seven more, from five states, were published in the *Canadian Field-Naturalist* and hence mapped in Houston (1969a). Although these had never been entered into the computerized database, Chandler S. Robbins (pers. comm., 20 December 2007) found that all seven were still extant in the recovery card file. Another possible reason for occasional missing records was that some cards, after many sortings, deteriorated to the point where they would "jam" the machine sorters and tabulators (Crissey 2006:193). Other records may have been found faulty and removed.

RESULTS

The earliest bird banders and bird banding in Saskatchewan.—The first publication of Saskatchewan banding results reported the use of unofficial, private, non-government-issue tags by A. W. Martin, near Findlater and Kinistino in 1921 (Figure 2). Each tag included Martin's name and address. Martin had come from his home in Port Arthur, Ontario, and caught ducks with the aid of his Chesapeake dog and a long-handled fishing net (Gollop 1961). Martin's report of results within the first hunting season after banding allowed mapping of 51 direct (first-season) recoveries from among 443 ducks and 2 coots, banded by

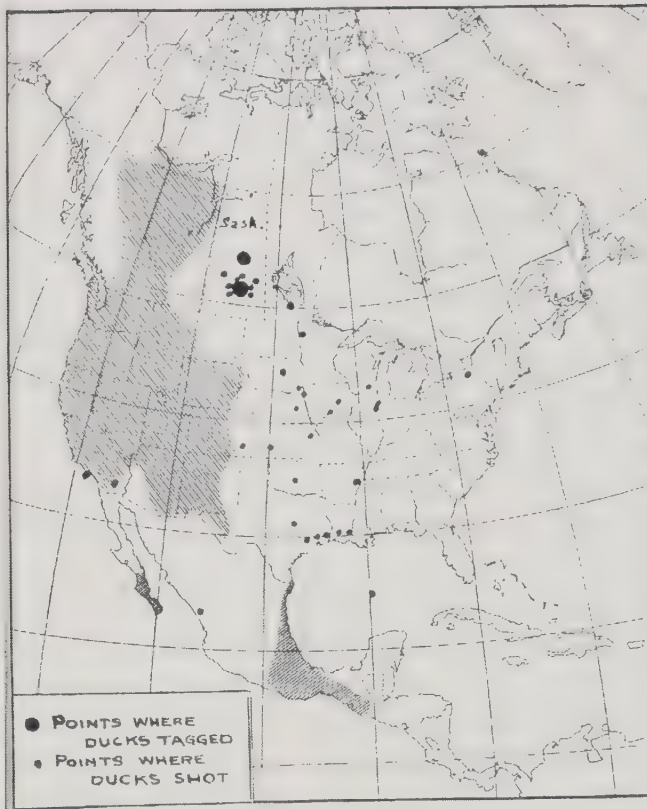


Figure 2. Recoveries of ducks banded by A. W. Martin near Findlater in 1921. Redrawn from Report of Saskatchewan Chief Game Guardian, year ending April 30, 1922. Duck species not provided.

him near Findlater and nine ducks banded near Kinistino. The report, with a map of the recoveries, was published where few researchers would find it – in the Annual Report of Saskatchewan’s Chief Game Guardian (Bradshaw 1922).

Use of a few official U.S. Biological Survey (the predecessor of the U.S. Fish and Wildlife Service) bands began in Saskatchewan in 1921, before the Canadian Bird Banding Office opened in 1923 (Brewer et al. 2000). The first official “return” of a Saskatchewan-banded bird received mention in three publications. It involved an American White Pelican (*Pelecanus erythrorhynchos*) captured in the fall of 1921 by A. F. Wolther at the railway dam at Morse. Wolther fed it fish and raw

meat; each day the pelican would fly over to the dam and each night it would return to the shelter of Wolther's barn. Fred Bradshaw, Saskatchewan's Chief Game Guardian (Figure 3) (with banding permit 002), provided Wolther with an aluminum band, #100553. With the advent of wintry weather, the pelican left on 22 October 1921 (Bradshaw 1922). Ten days later, on 1 November, the pelican was recaptured at Lindsay, South Dakota on the Cheyenne River, 785 km south, by F. L. Norman, who added a tag of his own on the opposite leg, giving his address. Word of this exciting event reached Wolther on 9 November, and appeared in the first-ever published list in *Canadian Field-Naturalist* two years later, but gave an incorrect banding date of 30 October 1921 (Canadian National Parks Branch 1924). In his classic 1939 book on the results of banding, Lincoln (1939b), in reporting the three most interesting pelican recoveries to that date, incorrectly stated



Figure 3. Fred Bradshaw (1870-1956), permit 002. Banded in southern Saskatchewan, 1921-1932. Photo courtesy Fred G. Bard.

that the pelican had been shot, and gave a recovery date of 27 October. The Wolther record is absent from the official printout. Another Bradshaw recovery involved a Double-crested Cormorant banded near Imperial Beach, Last Mountain Lake, and shot near Faribault, Minnesota (Houston 1990b). From his banding of 69 individuals of 8 species, including 25 waterfowl of 3 species in 1928 and 1929, Bradshaw had 2 Mallards (*Anas platyrhynchos*) that were shot locally and one in Illinois, and Northern Pintails (*Anas acuta*) shot in Kansas, Texas, and California (Houston 1990b).

Harry L. Felt (banded 1922-1931), the Canadian National Railway (CNR) station agent at Findlater, obtained permit 007 (Houston 1991a). Felt may have met A. W. Martin when he was banding ducks near Findlater for three weeks the previous summer. Haphazard banding by Felt for another 10 years, with some species misidentified, took second place to guiding wealthy U.S. hunters and Great Britain's Prince of Wales, who would park their expensive private railroad cars on a specially constructed siding at Findlater.

James C. Silver (banded only in 1922), a farmhand at Unity, with permit 008, banded six flightless ducks on 15 August and received four recoveries before the end of November; all three Gadwalls (*Anas strepera*) were shot (locally, in Texas; and in Arkansas) and the single Northern Pintail was shot locally (Houston 1990b).

Reuben Lloyd at Davidson (banded 1923-1937) (Figure 4), a farmer and agent for a land settlement company, with permit 014, banded 3177 individuals of 73 species over 14 years, from which he had 253 recoveries. His logbook omitted only the birds banded in 1923. For the first 10 years he was assisted by his son, Bert, whose life work was as a preparator with the Carnegie Museum in Pittsburgh. Of only three Swainson's Hawks (*Buteo swainsoni*) banded, two were recovered, one in Nebraska and one in Texas (Lincoln 1939b). The southward distribution of Lloyd's Mallard recoveries is displayed in Figure 5. A Canada Goose (*Branta canadensis*) was recovered in Texas, unusually far south; a Gadwall reached West Virginia; a Killdeer (*Charadrius vociferus*), Nebraska; a Dark-eyed Junco (*Junco hyemalis*), Iowa; and a Common Grackle (*Quiscalus quiscula*), Minnesota. A White-crowned Sparrow (*Zonotrichia leucophrys*) banded at Davidson on 16 September 1924 was caught in a trap by another bander, Edith B. Carman, at Grand Junction, Colorado, on 30 January 1933, nearly 9 years later, a longevi-



Figure 4. Reuben Lloyd (1871-1942), permit 014. Banded at Davidson and Last Mountain Lake, 1923-1937. Photograph courtesy of Albert C. Lloyd.

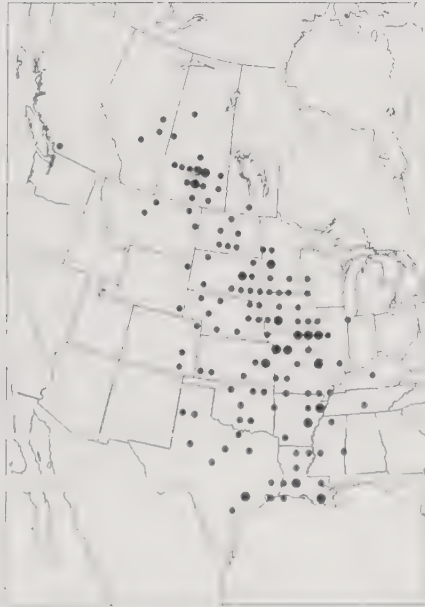


Figure 5. Recoveries of Mallards banded by Reuben Lloyd at Davidson, 1923-1925. Map by Kathy M. Meeres.

ty record (Lincoln 1933b). From 303 Double-crested Cormorant nestlings banded at nearby Last Mountain Lake, Lloyd had 62 recoveries; these show a disproportionate ratio of birds killed during their first southward migration (Houston 1969a).

R. H. Carter, Jr. (banded 1923-1961), farmed near Muscow (Houston 1945c, Callin 1980). Of the 5240 individuals of 70 species he banded, House Wrens (*Troglodytes aedon*) topped the list with 1470. Of 79 adult House Wrens banded in 1927 and 1928, 16 returned in the subsequent year. Some wrens raised two broods in one summer, keeping the same mate during both nesting efforts. None of his banded wrens retained the same mate for two years in succession and his adult wrens rarely returned to the same nest. From over a thousand wren nestlings, only four returned to be caught again the next year, but another dispersed 16 km to nest near Lipton. R. H. twice held the continent record for Hairy Woodpecker (*Picoides villosus*) longevity: one he banded in February 1924 was re-captured in 1925, 1927, 1928, and in February 1929 (Lincoln 1939b), and another banded 20 March 1927 was recaptured 1 November 1936, when at least 10 years, 4 months old (Cooke 1942b). From 80 Common Grackles banded, he had five recoveries, including one each from Missouri and Louisiana. He had an American Bittern (*Botaurus lentiginosus*) recovery in Arkansas, a Northern Flicker (*Colaptes auratus*) in Texas, and a House Wren in Vermont. An adult male Brown-headed Cowbird (*Molothrus ater*), banded 13 June 1929, was found dead at San Juan, New Mexico on 2 July 1929, possibly the first evidence of long-distance early southward movement of male cowbirds, 2025 km in 19 days. His most exciting recovery was a Bank Swallow (*Riparia riparia*, mistakenly assigned to a Barn Swallow, *Hirundo rustica*, Houston 2001); it was banded 7 July 1929 and found dead at El Carmen, Rio Madre de Dios in northern Bolivia in June 1935 (Lincoln 1939b).

John R. Carter (banded 1929-1952), a farmer, was assigned permit number 016, a lower number than his brother's. J. R. banded 1739 individuals of 61 species before he moved to Manitoba in 1952 (Houston 1968d). One of his major efforts was the banding of 624 House Wrens in his first 5 years. Of 11 adult wren returns, nine were recaptured at their nests in the subsequent year, one 2 years later, and one at 3 years. A Black-capped Chickadee (*Poecile atricapillus*) banded 5 December 1929 had its band number read through the window as it perched on his

outside window-sill on 1 February 1933. A nestling from Saskatchewan's third recorded nest of the Cooper's Hawk (*Accipiter cooperii*) was banded on 28 June 1929 near Muscow and shot at Balcarres, 26 km east, on 16 September. From 11 American Crows, J. R. had three recoveries: at Meota and in Oklahoma and Kansas. A Great Horned Owl (*Bubo virginianus*) nestling banded on 22 May 1932 traveled 185 km southeast, at the time the farthest travel of this species (Lincoln 1939a). From 91 Common Grackles banded, eight recoveries included six from Saskatchewan and one each from Louisiana and Texas. Mallards were shot in Iowa and Oklahoma, Blue-winged Teal (*Anas discors*) in Texas and Wyoming, and a Baltimore Oriole (*Icterus galbula*) in Iowa.

The greatest achievement of the Carter brothers (Figure 6) was the banding of nestling Red-tailed Hawks (*Buteo jamaicensis*), 35 by R. H.,



Figure 6. John R. Carter (1914-2007, behind bumper) and his brother, Richard H. Carter, Jr. (1904-1995). They banded at Muscow, 1929-1952 and 1923-1960, with permits 026 and 032, respectively. Photo courtesy of Reg Westagate and Dan Carter.

16 by J. R., in one or two nests per year, in large trees (*Populus* sp.) in coulees draining into the nearby Qu'Appelle River valley. The Red-tailed Hawk was then surprisingly uncommon in southern Saskatchewan (Houston and Bechard 1983). From 51 nestling Red-tails banded, there were 22 recoveries, 18 of them shot, stark testimony to the slaughter of this hawk in the 1920s and 1930s. These 22 recoveries defined the migration pathway and wintering grounds of Saskatchewan Red-tailed Hawks (Houston 1967b). Two Carter Red-tailed Hawks that lived 13 years and 8 months and 13 years and 7 months, held the North American longevity record into the 1970s (Cooke 1942a, Kennard 1975).

John A. MacDonald Patrick (banded 1926-1933) (Figure 7), a lawyer from Yorkton, visited the Quill Lakes in early July, 1929 to 1931, where he banded 1388 colonial birds. From roughly 450 cormorants and 940 pelicans banded, he obtained 81 cormorant and 73 pelican recoveries, percentages of 18% and 7.5%, double that obtained 30 to 40 years later. Both species were later mapped, demonstrating southward movements blanketing Illinois, one state farther east in the years before urbanization and industrial pollution (Houston 1967a). Patrick



Figure 7. J. A. M. Patrick (1873-1943), permit 021. Banded primarily at Quill and Foam lakes, 1926-1933. Photo courtesy of Bill Patrick.

banded 68 Black-crowned Night-Herons (*Nycticorax nycticorax*) near Foam Lake and from these had two recoveries. A Double-crested Cormorant, banded at Big Quill Lake on 6 July 1932, and found 9 years and 11 months later near Willow Lake, South Dakota, was briefly a longevity record (Cooke 1943).

For the rest of this paper I have chosen to deal with geographic areas in turn (see map, Figure 1 and Appendix A), rather than to continue a chronologic progression.

Southern Saskatchewan banders.—In southern Saskatchewan, Charles F. Holmes (banded 1928-1944), a farmer south of Dollard with a scientific permit to collect birds for study skin preparation, banded only 56 individuals of 14 species. Yet he chose well. From the 16 nestling Swainson's Hawks he banded, five were shot: one went north to White Bear, two to Montana, one to North Dakota, and one to Oklahoma (Houston 1945d).

Edgar Baynton (banded 1923-1934), a rancher at Bigstick Lake, banded 100 birds of 16 species. He interested two of his rancher-farmer neighbors in getting banding permits: Edward A. Atkinson banded 94 birds of 20 species, including 11 Sprague's Pipits (*Anthus spragueii*), three more than were entered into banding totals through 1951 (Van Velzen 1964). John A. Gold banded 62 birds of ten species. Atkinson had two of his Northern Pintails shot locally and Gold had an American Crow shot near Radville the following year (Houston 1991b).

George Lang (banded 1923-1939) (Figure 8), secretary-treasurer of the Canada Experimental Farm at Indian Head, banded 6313 individuals of 55 species (Houston 1945b). These included a prodigious 857 Black-crowned Night-Herons; his 31 night-heron recoveries spanned much of the migratory and wintering range of this species (Houston 1967c), including a heron that was found dead in Texas nearly 9 years after it was banded, a longevity record at that time (Cooke 1938a; Lincoln 1939b). One of his banded Northern Flickers was caught in Texas (Lincoln 1939b). The highest early interior banding total in North America (447) of Common Terns yielded only a single recovery — from Minnesota. Two banded Brewer's Blackbirds (*Euphagus cyanocephalus*) were recovered in Texas and a Common Grackle was shot in Arkansas (Houston 1978).

Walter Frederick Hammond (banded 1932-1942) farmed north of Cupar, where he banded 254 individuals of 13 species. From 150



Figure 8. George Lang (1872-1941), permit 054. Banded at Indian Head, 1923-1939. Photo courtesy of James H. Lang.

American Crows banded, he received 12 recoveries, one of which was a longevity record; he also had one recovery each of a Mallard (from Nebraska) and a Swainson's Hawk (Callin 1980, Houston 2003).

Arthur Ward (banded 1939-1957) (Figure 9), was born in Yorkshire, England, and came to Canada to farm in 1903 at age 27. Between 1939 and 1957, he banded 2820 individuals of 87 species and four subspecies. Ward provided several examples of a bander providing dates for unusual arrivals to his oasis-like farm shelterbelt on open prairie near Burnham, east of Swift Current. These are: Golden-crowned Kinglet (*Regulus satrapa*), 7 October 1946; Townsend's Solitaire (*Myadestes townsendi*), 8 August 1949; Varied Thrush (*Ixoreus naevius*), 7 September 1949; Yellow-breasted Chat (*Icteria virens*), 27 May 1949; Dickcissel (*Spiza americana*), 22 June 1953; Bullock's



Figure 9. Arthur Ward (1875-1958), permit 426. Banded at Burnham and Swift Current, 1939-1957. Photo courtesy of Colin Ward.

Oriole (*Icterus bullockii*), 7 and 8 August 1943; Red Crossbill (*Loxia curvirostra*), 18 July 1950; White-winged Crossbill (*Loxia leucoptera*), 13 October 1946 and again on 20 and 27 June 1947. After he moved into Swift Current, Ward banded a European Starling (*Sturnus vulgaris*) on 18 January 1954. He had six recoveries, two of special interest. A Brown Thrasher (*Toxostoma rufum*), banded 27 July 1943 was killed in a storm near Lucky Lake on 23 June 1944, and a juvenile American Robin, banded 27 Aug 1944, was killed 24 July 1946 by a cat at Kerrobert, both suggesting northward natal dispersal of 80 and 220 km, respectively (Houston 2005a).

Arthel Simard (banded 1938-1939) owned a grocery and dry goods store in Cabri. He banded 70 birds of 16 species, including the first Prairie Falcon (*Falco mexicanus*) banded in Saskatchewan; it was found

injured 16 days later. He also banded the first adult male Cinnamon Teal (*Anas cyanoptera*) in Saskatchewan. Of four Black-billed Magpies (*Pica hudsonia*) banded, two were shot locally. A Mallard and a Gadwall he banded were shot locally and a Blue-winged Teal was shot in Montana.

Regina area banders.—Fred G. Bard (banded 1928-1962) (Figure 10), of the Saskatchewan Provincial Museum (renamed the Saskatchewan Museum of Natural History in 1955) banded 13,364 individuals of 104 species. Because he spent much of his effort banding waterfowl and colonial birds, he had an unprecedented 1323 recoveries. Most of the colonial birds were banded at Last Mountain Lake. The recovery rate of 18.5% from 2038 Double-crested Cormorants, 9.0% from 958 American White Pelicans, 4.6% from 2408 Ring-billed Gulls (*Larus delawarensis*), and 12.4% from 128 Common Grackles, were all appreciably higher than from post-1955 banding efforts. Total numbers for the colonial species exceeded that of any other Saskatchewan bander of his era. Franklin's Gulls (*Larus pipixcan*) and Common Terns, however, had only three recoveries from 270, and two from 1244 banded, respectively. Six maps of Bard's cormorant and pelican movements are depicted in Houston (1970a).



Figure 10. Fred G. Bard (1908-1989), permit 151. Banded widely, 1928-1962. Photo courtesy of Fred W. Lahrman.

Bard's assistant at the museum, Nicholas Albulet (banded 1934-1936), banded 26 Western Meadowlarks (*Sturnella neglecta*) and one Sora (*Porzana carolina*). An Eastern Kingbird (*Tyrannus tyrannus*) was recovered locally. Bard's confrere A. E. Etter, Saskatchewan Game Commissioner in 1929-1930, banded 14 Mallards and four Canvasbacks (*Aythya valisineria*) in 1932 (Houston, mss.).

Another Regina bander, J. A. Briggs (banded 1925-1948), a Canadian National Railroad employee, carried bands with him as he traveled widely on a "jigger" – a small, hand-pumped vehicle that rode on the rails—checking condition of the railroad tracks that radiated out from Regina (Houston and Houston 2003). He banded 324 nestling Northern Flickers in cavities in utility poles placed along the tracks. In addition to returns in subsequent years, one flicker was killed in a storm in Oklahoma and one was shot in Texas. From 61 nestling American Crows, he had five local recoveries, one in Nebraska, and two near Hutchinson, Kansas. Of nine Black-billed Magpies, one was caught in a trap locally and the other was shot 350 km to the east. A Brewer's Blackbird was shot in South Dakota and a Common Grackle was shot in Minnesota. Briggs banded 1076 birds of 24 species, with 19 recoveries (Houston and Houston 2003).

Dick Bird (banded 1941-1949) owned a camera store in Regina, Bird Films Limited, but was also a well-known Disney and Audubon Lecture Tour cinemaphotographer (Houston 1986). From 91 individuals of 20 species, Bird had local recoveries of one Swainson's Hawk and one flicker. A nestling Northern Harrier (*Circus cyaneus*) was shot the next February in Nuevo Leon, Mexico.

Saskatoon area banders.—Four farmers banded in the Saskatoon area (Houston 2002a). Philip Siemens (banded 1928-1937) farmed near Hepburn. From 416 individuals of 32 species banded, his recoveries included a Loggerhead Shrike (*Lanius ludovicianus*) found dead in Missouri (Lincoln 1939b) and a Northern Flicker in Missouri. Of six Red-tailed Hawks, Siemens had four recoveries the same year: one each in Iowa and Oklahoma and two in Texas. Abram S. Loewen (banded 1936-1938) of Hepburn banded 166 birds of 22 species. A Northern Flicker was shot in Oklahoma and a Loggerhead Shrike was killed in a thunderstorm in Texas. Henry D. Goosen (banded 1934-1939) banded 217 birds of 22 species at Dalmeny. An adult Barn Swallow and a Common Grackle returned to his farm in a subsequent year, but he had

no distant recoveries. John J. Dick banded in 1929 near Elstow. Of 10 Mallards and 2 Northern Pintails and 14 smaller birds, Mallards were shot in South Dakota and Colorado, and a pintail was shot locally.

In the city of Saskatoon, the first bander was high school student Farley M. Mowat (banded 1935-1937). Mowat applied for a banding permit two days after his 14th birthday; later he admitted he had written his age “illegibly” as 19. He banded 256 birds of 18 species (Houston 2002b). An American Kestrel (*Falco sparverius*) was shot in Texas the following winter (Lincoln 1939b).

The other Saskatoon bander prior to 1955 was Arnold McPherson (banded 1946-1952), a baker by trade. He banded 1288 individuals of 39 species. Of his 46 recoveries, 31 were of waterfowl: his banded Mallards were shot in 12 states; Northern Pintails in Nome, Alaska, and Sinaloa, Mexico; American Wigeons (*Anas americana*) in Nevada and North Dakota; and a Blue-winged Teal in Minnesota. Fourteen American Robin (*Turdus migratorius*) recoveries were local, but two others were shot in Texas and Virginia (Houston 2002b).

Hartley Fredeen (banded 1938-1943) (Figure 11), was home-schooled on a ranch west of Macrorie (Houston and Roy 2003). In the six years beginning with his 18th birthday, he banded 1762 individuals of 74 species, from which he had 47 recoveries, including 23 from 4 species of waterfowl (Houston 1968b). From 29 Swainson's Hawk nestlings, he had three recoveries, one of which was the first Swainson's recovery in Argentina (Cooke 1943) – and the first anywhere south of the Rio Grande—banded as a nestling near Macrorie on 21 July 1940, and shot in Cordoba province, 23 December 1941 (Houston 1968c). Individual Northern Harriers were shot in Nebraska and found dead in Oklahoma. Single American Crows were shot in South Dakota, Nebraska, and Oklahoma. An American Wigeon was caught by a dog near Salt Lake City, Utah. A Loggerhead Shrike was found dead in Oklahoma; a Barn Swallow was found dead in South Dakota; a Western Meadowlark was shot in Oklahoma; two Red-winged Blackbirds (*Agelaius phoeniceus*) went to Minnesota, and one Common Grackle each went to Arkansas and Mississippi. An adult Brewer's Blackbird, banded in late May, was found two years later at Tramping Lake, 155 km farther north. Two Barn Swallows banded as nestlings were found the following June near Coderre and Cadillac, 138 km and 173 km, respectively, evidently indicating distances of natal dispersal.



Figure 11. F. J. Hartley Fredeen (1920-2003), permit 369. Banded at Macrorie, 1938-1943. Photo courtesy of Margaret Fredeen.

Ralph and Alan Hedlin (banded 1938-1939) met Hartley Fredeen by correspondence through the Young Cooperator's section in the weekly farm newspaper, the *Western Producer*, and were persuaded by Hartley to take up bird banding in 1938. Ralph and Alan, double first cousins on adjacent farms near Renown, shared a joint banding permit. The Hedlins banded 430 individuals of 24 species, producing seven recoveries: a Swainson's Hawk killed locally, a Loggerhead Shrike recovered at Gainsborough, 395 km to the southeast, and five American Crow recoveries, the farthest at Tichfield and Lanigan (Houston 2005a).

Thomas Harper (banded 1933-1940), banded 418 birds of 29 species on a farm west of Simpson. From these he had 12 recoveries, including a Northern Flicker and a Downy Woodpecker (*Picoides pubescens*) found dead nearby, and another flicker that was found dead in Texas over a year after it was banded.

Yorkton area banders.—There were banding stations on three farms north of Yorkton (Houston 2003). The Wotherspoon brothers, Lindsay and Bill (banded 1931-1941), at Hyas, banded 885 individuals of 42 species, yielding 20 recoveries (Houston 1945a). From 20 Northern Harriers banded as nestlings, eight were reported shot: four in Texas, and one each in Missouri, Florida, Oklahoma, and Louisiana. The Louisiana and two of the Texas recoveries were from the same brood of three. Robert Blakeley (banded 1929-1930) banded 82 individuals of 18 species at Tadmore. From three Red-tailed Hawks banded, two were shot in Texas. Emma Wickencamp (banded 1933-1939), banded 207 individuals of 28 species near Stenen and had a remarkable nine recoveries, including a Red-tailed Hawk killed at Buffalo Bayou, Texas (Lincoln 1939b).

I was also a Yorkton bander, hired to band at age 15 by Ducks Unlimited Canada (DUC) in 1943 at 10 cents per duck that year and then at the lucrative rate of 20 cents per duck in four subsequent summers. With a concentration on waterfowl, and beginning work on colonial birds and raptors, I amassed 748 recoveries of 20 species from banding of 6712 individuals of 92 species through the end of 1954.

Central Saskatchewan banders.—In central Saskatchewan, Homer Myers (banded 1937-1939), occupation unknown, banded 245 birds of 22 species at Rabbit Lake. When pre-1955 recoveries were entered into the computer some years later, a clerk in the banding office entered the latitude and longitude of a small lake, Rabbit Lake, southeast of Redberry Lake, rather than the village of Rabbit Lake where Homer Myers lived. A Barn Swallow was tangled in a net, and an Eastern Kingbird was caught in a fish net locally. A Western Meadowlark was shot in Oklahoma (Houston 2005a).

Robert C. Willett (banded 1937-1939) as a high school student banded 186 birds of 17 species at Cochin. With the help of R. D. Symons, local game warden, Willett was able to obtain a bird banding permit when he turned 16. He built a drop trap, pulling a string when migrating American Tree Sparrows (*Spizella arborea*) and Dark-eyed Juncos were beneath it. His *tour de force* was to band a single Bobolink (*Dolichonyx oryzivorus*), and have this “rice bird” caught during its migration through Louisiana (Houston 2005a).

Nipawin area banders.—At Nipawin, Maurice G. Street (banded 1945-1960) (Figure 12), a rural oil delivery man and his three farmer proteges, had three active banding stations (Houston and Street 1959). Street banded 14,187 individuals of 103 species and had 327 recoveries of 19 species; Billy Matthews (banded 1950-1958), banded 11,270 birds of 95 species, and Stuart J. Francis (banded 1954-1959) banded 1688 birds of 34 species at Torch River. Before mist nets became available and in vogue, Street used a single water-drip trap to capture 3120 Tennessee Warblers (*Vermivora peregrina*), including 462 Tennessees in 1952, for the highest individual banding total to that time for this species in North America. He had three Tennessee Warbler recoveries, one of them appropriately from Tennessee, and the others from Manitoba and Wisconsin. Street also had recoveries of American Bittern (two); Red-tailed Hawk (six, including Iowa, Wisconsin, Kansas, Missouri); Merlin (*Falco columbarius*, one, shot in New Mexico); Great



Figure 12. Maurice G. Street (1910-1966), permit 520. Banded at Nipawin, 1945-1960. Photo courtesy of Bonnie Street.

Horned Owl (two); Hairy Woodpecker (one); Blue Jay (*Cyanocitta cristata*, three); Black-billed Magpie (two, shot, one 64 km distant); Black-capped Chickadee (one); American Robin (four); Bohemian Waxwing (*Bombycilla garrulus*, one, shot 60 km south the subsequent winter); Rose-breasted Grosbeak (*Pheucticus ludovicianus*, one); Chipping Sparrow (*Spizella passerina*, one, killed locally by a cat 3 years later); Harris' Sparrow (*Zonotrichia querula*, one, shot in Iowa, 5 years later); Purple Finch (*Carpodacus purpureus*, one, shot locally 3 years later); Pine Grosbeak (*Pinicola enucleator*, one, an adult female found dead at Nipawin when at least 6 years old); Common Redpoll (*Carduelis flammea*, one, shot at Patuanak, 365 km northwest, early the subsequent winter); and Evening Grosbeak (*Coccothraustes vespertinus*, three in subsequent seasons at Middle Lake, Hyas, and Lebret, at 135, 210, and 295 km, and one that flew 1165 km to hit a picture window at Danbury, Wisconsin). Matthews and Francis had high totals for Common Redpolls (3804 and 654, respectively) and Dark-eyed Juncos (2176 and 483). Three Common Redpolls banded at Nipawin were found dead: one 400 km southeast at Ste. Rose de Lac, Manitoba, one year later (banded by Matthews); one shot 1970 km east the following winter at Bluevale, Ontario; and one found dead 2540 km east at South Shaftesbury, Vermont, two years after it was banded. A Loggerhead Shrike was found dead at Weldon nearly 5 years after it was banded. Stuart J. Francis banded 56 Mallards, with nine shot in Saskatchewan; one Green-winged Teal (*Anas crecca*) he banded was shot in Kansas (Houston and Street 1959).

Street and Matthews caught and released more birds banded elsewhere than any other Saskatchewan banders (Houston and Street 1959). White-throated Sparrows (*Zonotrichia albicollis*) banded by Gary Kuyava in Duluth, and Marie Thompson in Minneapolis, Minnesota, and J. W. Baechle at Collegeville, Indiana, were each recaptured by Street at Nipawin. Evening Grosbeaks banded by Margaret Hickey at Madison, Wisconsin, and by Mary Ross at Marquette, Michigan, were recaptured by Matthews. An American Robin banded by Amelia Laskey in Nashville, Tennessee, was caught and released by Street.

Banding of Mallards was done near Waskesiu under two Prince Albert National Park superintendents (Houston 2005b): B. I. M. Strong (1951, 25 banded with six recoveries) and J. D. B. MacFarlane (1954-1956, 198 banded with 52 recoveries). Ronald and Donald Hooper

banded 177 birds of 26 species (1954-1956) on their father's farm near Somme; no recoveries resulted (Houston 2005a).

Other Saskatchewan banders.—At the BBL I located and copied banding schedules from five banders who were not assigned band permit numbers (Houston 2005a): O. C. Furniss (banded 1932-1933), a teacher at Prince Albert, banded 39 individuals of five species; Brian Isinger (banded 1954-1956), a public school teacher at Big River and Yellow Creek, banded nine nestling Purple Martins (*Progne subis*); E. H. M. Knowles (banded 1934), a lawyer in Regina banded 15 birds of six species; Lawrence B. Potter (banded 1929), a rancher at Eastend, banded three Mountain Bluebirds, *Sialia currucoides*; and Marie H. Willers (banded 1927-1938), of Viceroy and Ellisboro, tagged 188 birds of 30 species. Willers became a primary school teacher and published a textbook in which she spoke of the values and nature of bird banding (Willers 1936).

Visitors from out-of-province included two banders from Waukegan, Illinois. William I. Lyon, a realtor, and H. E. McArthur, a postal worker, twice came to Saskatchewan together. In 1936, they banded a Marbled Godwit (*Limosa fedoa*) east of Yorkton on 1 July, and four nestling Northern Harriers, a Killdeer and a Willet (*Catoptrophorus semipalmatus*) near Indian Head on 2 July. On 4 July, they banded 33 Ring-billed Gulls at Imperial Beach, Last Mountain Lake, with two recoveries, and six Double-crested Cormorants. There they met Fred Bard, another bander. Lyon and McArthur banded a Marbled Godwit at Elstow and spent two days at Redberry Lake before going on to the marsh near Cochin to band Franklin's Gulls and Forster's Terns (*Sterna forsteri*).

In 1937 Lyon and McArthur visited Chael Marsh near Henribourg on 4 July, banding 244 Franklin's Gulls from which they got three recoveries; Waterhen marsh near Kinistino on 5 July, banding 47 Franklin's Gulls with no recoveries, and Redberry Lake on 6 and 7 July. From the 328 White Pelicans, 153 Double-crested Cormorants, and 328 California Gulls (*Larus californicus*) banded during two visits to Redberry Lake, they had 41 pelican (12.5%), 31 cormorant (20.3%), and 12 gull (3.4%) recoveries (Houston 1968g).

Roland Williams came from Wisconsin to canoe the Churchill River in 1926, where he banded one Mallard each at Dipper Rapids and Knee Lake; the latter bird was shot near Ille-à-la-Crosse. Other visitors

to Saskatchewan were Burt Gresham of Winnipeg, Manitoba (unknown number of White Pelicans banded at Quill Lakes in 1939; one was found dead locally, one shot in Illinois, and one injured in Oklahoma). H. O. Todd visited Woodrow from Murfreesboro, Tennessee in 1947 and 1949 (seven crow recoveries including one in Oklahoma). D. G. Colls, a wildlife bird officer from Winnipeg banded seven Canada Geese at Duck Mountain Provincial Park in 1951; five of them were shot together at Oak Lake, Manitoba on 2 and 3 November that fall (Houston 2005b).

Waterfowl biologists sent by the U.S. government to study the massive drop in duck populations in the 1930s were Webb H. Ransom (1934-1936), and George B. Saunders, given the new title of "Flyway Biologist" in 1936. In 1947 and 1948, Cecil S. Williams banded 3420 and 2029 ducks, respectively, of 11 species, resulting in 569 recoveries (Houston 2005b).

Robert C. McClanahan (banded 1940-1941) of the U.S. Fish and Wildlife Service in Washington, D.C., visited Saskatchewan twice. In 1940, he banded three Ferruginous Hawk (*Buteo regalis*) nestlings and three Double-crested Cormorants. In 1941, he banded 132 Ring-billed Gulls at Imperial Beach, Last Mountain Lake; from these he had two recoveries, one of which was found dead in Guanajuato, Mexico, while the other died in California at 11 years, 4 months of age, then a possible longevity record.

Floyd Thompson (banded 1950-1954) was the first of the "U. S. Game Management Agents" who came into Canada to study waterfowl populations, breeding conditions, food habits, and nesting success (Houston 2005b). One component of their assignment was to band ducks. Thompson pioneered "drive-banding" of molting ducks (Hawkins et al. 1984). Each agent came with one or two state biologists or technicians, and often worked with Canadian Wildlife Service and Ducks Unlimited personnel in conducting duck drives. One such drive, on a shallow marsh near Kerrobert in 1952, netted an incredible number of molting flightless adult males: 2025 Northern Pintails, 1393 Green-winged Teal, 447 Blue-winged Teal, and 112 Mallards. Under Thompson's master permit between 1950 and 1954, 24,263 waterfowl of 15 species were banded, including 9557 Northern Pintails, with 956 recoveries (Houston 2005b).

John J. Lynch (banded 1949) visited Eyebrow Marsh at Tugaskie to band 3733 ducks of ten species, led by 1172 Blue-winged Teal, 1135

Northern Pintails, and 884 Mallards; from these there were 428 recoveries. Jerome J. Stoudt (banded 1952-1972) began his banding studies of waterfowl in the Redvers area in 1952, banding 498 during the first three years, with 116 subsequent recoveries (Houston 2005b, Houston and Dzubin 1998). Several waterfowl banders followed in quick succession, beginning in 1954, when R. J. Buller from New Mexico and Rex Tice from Ohio came once, Don W. Kriebel came from Texas for his first of two years, and Charles R. Hayes came from Colorado for the first of three annual banding visits.

J. Bernard Gollop (banded 1952-1958) (Figure 13), was the first major Saskatchewan waterfowl bander with the Canadian Wildlife Service. In 1952, Gollop caught young Mallards by wading in sloughs near Kindersley with fish landing-nets, but in 1953 he began using a

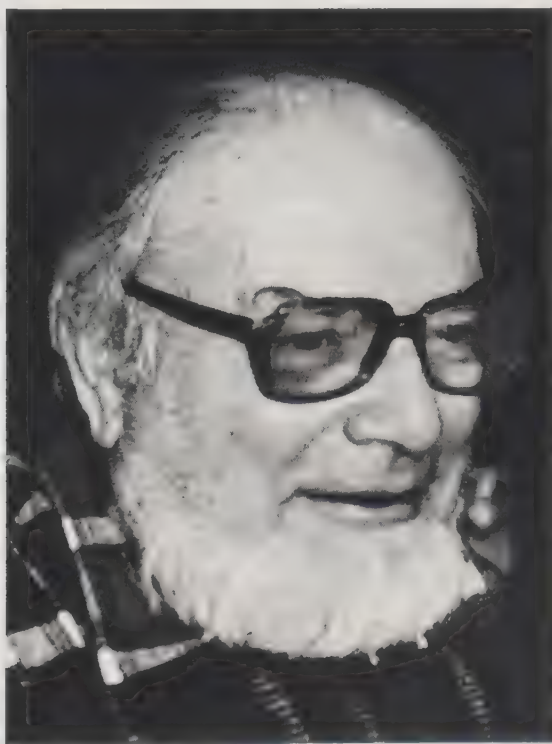


Figure 13. J. Bernard Gollop (1926-2000), permit 592. Banded primarily near Kindersley, 1952-1958. Photo courtesy of Madeleine Gollop.

soft-mouth Golden Labrador Retriever, which caught 1818 Mallards in the first three years. Gollop (1956) reported that this pioneering use of retrievers offered "the most practical technique . . . to catch an adequate, well-distributed sample" of Mallards and Northern Pintails. Between 1952 and 1954, Gollop banded 4284 waterfowl of 11 species with 529 recoveries.

Lincoln (1939b) cited only three important records of birds banded in the United States that traveled north and were recovered in Saskatchewan. Saskatchewan banders were connected with two of these. Bander Reuben Lloyd at Davidson was the collector of the first Great Egret (*Ardea alba*) ever recorded in Saskatchewan, on 4 August 1937; it carried a band applied by Ben B. Coffey, Jr., at Glen Allan, Mississippi on 24 May 1936 (Cooke 1938b), and is now a specimen in the Royal Saskatchewan Museum. A Hairy Woodpecker banded at East Bay, Manitoba by E. Robinson, was found dead at Spirit Lake, Saskatchewan by John Gunn, father-in-law of bander William Anaka. A Bohemian Waxwing banded at Waukegan, Illinois, on 25 March 1932 by W. I. Lyon was found injured 21 days later at Craik, Saskatchewan, 1660 km distant.

B. W. Cartwright (1952, 1956), chief naturalist, Ducks Unlimited Canada (DUC), published two editions of a booklet, "Waterfowl banding by Ducks Unlimited," listing all waterfowl banding by DUC through 1950, and then updated through 1954. Maps in the booklet indicated with color-coded dots the province of origin of banded Mallard, Northern Pintail, Blue-winged Teal, and Lesser Scaup (*Aythya affinis*).

DISCUSSION

Saskatchewan farmers, and others in a predominately rural province, showed a somewhat disproportionate interest in the new avocation, bird banding. Prior to 1955 in Saskatchewan, only two banders, Mrs. F. Wickencamp and Marie H. Willers, were female (Table 1). The early banders, with the exception of one lawyer, lacked a University degree. A few obvious but understandable identification errors were made, for example, Loggerhead Shrikes were misidentified as Northern Shrikes (*Lanius excubitor*). The remainder of the records submitted suggest that all but two (Dick and Felt) quickly learned to identify the birds

they banded. Effort and enthusiasm varied, but the 15 who banded 1000 or more individuals had found an avocation they performed with a passion.

For a few, bird banding replaced egg-collecting as the central theme in bird study. In the case of Charles Holmes, banding remained subsidiary to sanctioned study-skin collecting. Those who focused their banding efforts on raptors, corvids, blackbirds, and colonial birds achieved the highest recovery rates.

There were no major banding projects in adjacent provinces until two Alberta banders, William Rowan (1927), and Frank L. Farley (1932), became involved in extensive gull-banding projects, and Salt undertook one of the largest early raptor-banding projects in North America in the "badlands" near Rosebud, east of Calgary (Salt 1939a,b). In Manitoba, the waterfowl station at Delta was established in 1938 with the hiring of H. Albert Hochbaum (Sowls 1955).

Curiosity among the band finders seems to have fueled a high rate of reporting birds with bands. Prior to 1940, banding of Black-crowned Night-Herons by Lang (Houston 1978); American White Pelicans and Double-crested Cormorants by Lloyd (Houston 1969a), Patrick (Houston 1967a), and Lyon (Houston 1968g); Mallards by Lloyd (Figure 5); Red-tailed Hawks by the Carter brothers (Houston 1967b); and American Crows by Bard (Houston 1969b), thereby proved sufficient to show the normal migration paths of these birds from Saskatchewan. Merging the recoveries of all Saskatchewan banders combined, later allowed mapping of migration routes for the Northern Harrier (Houston 1968a), Swainson's Hawk (Houston 1968c), American Robin (Houston 1968f), and Common Grackle (Houston 1968e). Banders' time, field work, transportation, and equipment were at his or her personal expense, so the knowledge gained was at the minimal cost of record-keeping to the governments of Canada and the United States. Only when the *Blue Jay* (published by the Saskatchewan Natural History Society) began publication in the fall of 1942 was there a regional outlet for publication by Arthur Ward, Maurice Street, and me.

Early banders experienced what would now be considered high recovery rates, especially for species robin size or larger. In the 1920s and 1930s, more birds were shot than would be the case today; Double-crested Cormorants, Common Grackles, and Brewer's Blackbirds were often shot on sight. Many members of the general public retained the

already discredited notion that “the only good hawk is a dead hawk,” so raptors frequently met their death by a shotgun when only a few months old. However, declining recovery percentages have involved all Saskatchewan species for which sufficiently large samples exist over time; the graph for the Ring-billed Gull is representative (Figure 14; Houston and Houston 2006).

The complete absence of Swainson’s Hawk recoveries from south of the Rio Grande, of birds banded anywhere in North America until 1941, is surprising. Clearly the language barrier was a major contributor. However, since the 1940s and 1950s, recoveries from south of the Rio Grande have increased substantially, perhaps associated with increased Latin American incomes, more universal literacy, and better communication.

Why did Saskatchewan have a disproportionate number of banders? There is no simple answer. Undoubtedly it was easier to obtain a

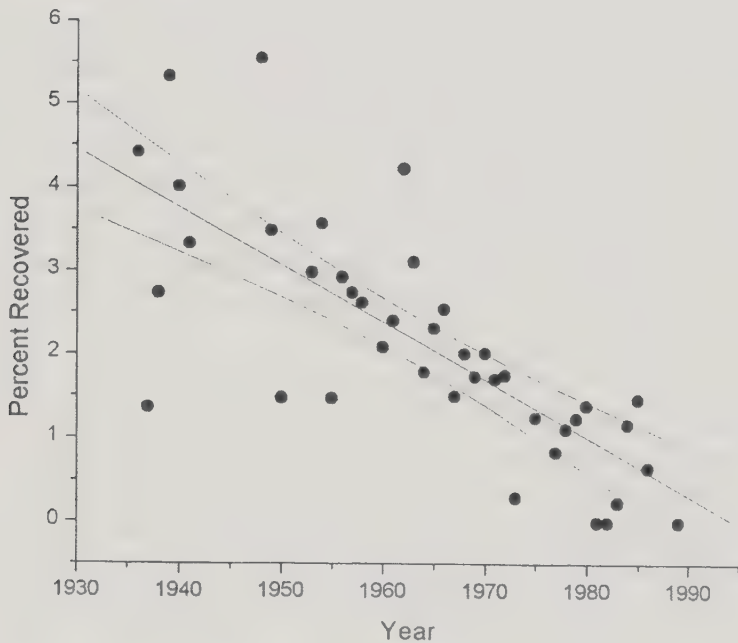


Figure 14. Declining annual rates of percent recoveries of Ring-Billed Gulls banded in Saskatchewan, 1936 - 1989. Each dot represents the percent recovered in that year, with regression line and 95% confidence intervals . $r^2 = 0.35$, $p = 0.00003$.

banding permit in Canada than in the United States. Anyone in rural Canada, far from any ornithologist who could vouch for him or her, was promptly issued bands if that person chose to apply. One might consider the agrarian nature of the province, where people living close to the land might have a greater interest in the natural world – except that such motivations should pertain to other rural states and provinces. Perhaps it was because of Saskatchewan's geographic and ecological position — in the heart of the prairie-pothole region where ducks abound and also where eastern and western species overlap (Houston and Anaka 2003).

An early scientific experiment concerning Brown-headed Cowbird homing involved Fred Bard (in Saskatchewan) and William Lyon (in Illinois) following their meeting at Last Mountain Lake. In 1936, Lyon shipped 30 banded cowbirds from Waukegan to Regina for release by Bard. Released on 10 May, cowbird 34-248720 was re-trapped by Lyon back at Waukegan on 16 June 1937, after it had traveled at least 1550 km. Its return was not as quick as that of B258155, released in Edmonton, Alberta, on 10 May, which checked in 2250 km distant at Waukegan on 31 May (letter from F. H. H. Williamson, Controller, National Parks Bureau, Ottawa, to Lyon, 19 November 1937).

New information about some aspects of bird behavior has come to light through banding in Saskatchewan and Manitoba. My own waterfowl banding in the 1940s, and that at the Waterfowl Research Station at Delta, Manitoba (Sowls 1955), revealed that female dabbling ducklings show high philopatry in subsequent years, while males disperse more widely. Only the Carter brothers banded enough of one passerine species – the House Wren — with adequate follow-up to contribute new information on reproductive behavior and fidelity. The Carter brothers' House Wren studies were detailed and exemplary and under other circumstances would have merited publication.

ACKNOWLEDGMENTS

I thank H. M. Reeves for calling my attention to the autobiography of Walter Crissey, the first Director of the Migratory Bird Populations Station at the Patuxent Research Center, Laurel, Maryland. Crissey's book provides details concerning transference of banding and recovery data from written schedules onto punch cards, and later into a computer. Reeves also provided information on early waterfowl banders in

Saskatchewan and defined the title, "U.S. Game Management Agents." Jay Sheppard, Earl B. Baysinger, and Chandler S. Robbins provided information about changing methods in the Bird Banding Office at the Patuxent Research Refuge, Laurel, Maryland (Houston et al. 2008). Alex Dzubin provided useful comments concerning waterfowl banding. I am indebted to Carol Beaulieu for preparing figure 1 and Kathy M. Meeres for preparing figure 5. Chandler S. Robbins corrected errors and Jerome Jackson greatly improved the manuscript. Mary I. Houston acted as my research assistant throughout the final 56 years of this 66-year project.

LITERATURE CITED

- Bradshaw, F. 1922. Report of the Chief Game Guardian. Pp. 329-382 *in* Annual Report, Saskatchewan Department of Agriculture, Regina, Saskatchewan.
- Brewer, D., A. Diamond, E. J. Woodsworth, B. T. Collins, and E. H. Dunn. 2000. Canadian Atlas of Bird Banding. Volume 1. Canadian Wildlife Service, Ottawa.
- Callin, E. M. 1980. Birds of the Qu'Appelle, 1857-1979. Special Publication no.13, Saskatchewan Natural History Society, Regina.
- Canadian National Parks Branch. 1924-1932. Official Canadian record of Bird-banding returns. Canadian Field-Naturalist 38:91-93; 38:133-135; 38:154-157; 38:177-179; 38:190-191; 39:18-19; 39:39-40; 39:54-55; [39:82-83]; 39:119-122; 39:169-171; 39:191-193; 39:206-209; 40:62-64; 40:106-110; 40:158-164; [41:66]; 41:94-98; 41:141-144; 41:157-171; [41:191-195, 41:203-207; 42:18-24]; 42:107-110; 42:128-129; 42:151-161; 43:42-46; 43:67-68; 43:86-91; 43:138-143; 43:192-196; 44:72-76; 44:171-176; 45:44-48; 45:150-154; 46:70-74.
- Cartwright, B. W., 1952, 1956. Waterfowl banding by Ducks Unlimited, 1939-1954. Ducks Unlimited, Winnipeg, Manitoba.
- Cooke, M. T. 1938a. Returns of banded birds: recoveries of banded marsh birds. Bird-Banding 9:80-87.
- Cooke, M. T. 1938b. Some interesting recoveries of banded birds. Bird-Banding 9:184-190.
- Cooke, M. T. 1942a. Returns from banded birds: some longevity records of wild birds. Bird-Banding 13:34-37.
- Cooke, M. T. 1942b. Returns from banded birds: some longevity records of wild birds. Bird-Banding 13:70-74.
- Cooke, M. T. 1943. Returns from banded birds; some miscellaneous recoveries of interest. Bird-Banding 8:67-74.
- Crissey, W. F. 2006. Migratory bird population station. Chapter 10. Pp. 192-221, *in* A Life Like No Other: The Autobiography of Walter F. Crissey. iUniverse, Inc., New York.
- Environment Canada. 1991. Glossary of bird banding terminology. Appendix A, North American Bird Banding Manual, volume 1, A1-A8.

- Farley, F. L. 1932. Birds of the Battle River region. Institute of Applied Art, Edmonton, Alberta.
- Gillespie, M. 1930. Suggestions for a revised bird-banding terminology. *Bird-Banding* 1:14-19.
- Gollop, J. B. 1956. The use of retrievers in banding flightless young Mallards. *Transactions of the 21st North American Wildlife Conference*: 239-248.
- Gollop, J. B. 1961. A. W. Martin: early Saskatchewan bander. *Blue Jay* 19:118.
- Hawkins, A. S., R. C. Hanson, H. K. Nelson, and H. M. Reeves. 1984. *Flyways: pioneering waterfowl management in North America*. U. S. Fish and Wildlife Service, Washington, D.C.
- Houston, C. S. 1945a. Saskatchewan bird banders #1, Wotherspoon brothers of Hyas and #2, Arthur Ward of Burnham. *Blue Jay* 3:11-12.
- Houston, C. S. 1945b. Saskatchewan bird banders #3, George Lang of Indian Head. *Blue Jay* 3:28.
- Houston, C. S. 1945c. Saskatchewan bird banders #4, R. H. Carter, Jr. of Muscow. *Blue Jay* 3:37.
- Houston, C. S. 1945d. Saskatchewan bird banders #5, Charles F. Holmes of Dollard and #6, W. F. Hammond of Cupar. *Blue Jay* 4:8-9.
- Houston, C. S. 1967a. Saskatchewan bird banders #8, Judge J. A. M. Patrick. *Blue Jay* 25:172-174.
- Houston, C. S. 1967b. Recoveries of Red-tailed Hawks banded in Saskatchewan. *Blue Jay* 25:109-111.
- Houston, C. S. 1967c. Recoveries of Black-crowned Night Herons banded in Saskatchewan. *Blue Jay* 25:112-113.
- Houston, C. S. 1968a. Recoveries of Marsh Hawks banded in Saskatchewan. *Blue Jay* 26:12-13.
- Houston, C. S. 1968b. Saskatchewan bird banders #9, F. J. Hartley Fredeen of Macrorie. *Blue Jay* 26:85.
- Houston, C. S. 1968c. Recoveries of Swainson's Hawks banded in Saskatchewan. *Blue Jay* 26:86-87.
- Houston, C. S. 1968d. Saskatchewan bird banders #10, John R. Carter of Muscow. *Blue Jay* 26:118.
- Houston, C. S. 1968e. Recoveries of Bronzed Grackles banded in Saskatchewan. *Blue Jay* 26:136-138.
- Houston, C. S. 1968f. Recoveries of [American] Robins banded in Saskatchewan. *Blue Jay* 26:182-184.
- Houston, C. S. 1968g. Saskatchewan bird banders #11, William I. Lyon and H. E. McArthur. *Blue Jay* 26:185-187.
- Houston, C. S. 1969a. Saskatchewan bird banders, #12, Reuben and A. C. Lloyd of Davidson. *Blue Jay* 27:24-27.
- Houston, C. S. 1969b. Recoveries of the Common Crow banded in Saskatchewan. *Blue Jay* 27:84-88.
- Houston, C. S. 1970a. Saskatchewan bird banders #13, Fred G. Bard. *Blue Jay* 28:150-156.
- Houston, C. S. 1978. George Lang: pioneer ornithologist of Indian Head. *Blue Jay* 36:7-11.
- Houston, C. S. 1986. In memoriam: Dick Bird, 1892-1986. *Blue Jay* 44:209-212.
- Houston, C. S. 1990a. Early Saskatchewan banders in perspective [#16]. *Blue Jay* 48:204-208.

- Houston, C. S. 1990b. Saskatchewan bird banders #17, Fred Bradshaw and proteges. *Blue Jay* 48:209-211.
- Houston, C. S. 1991a. Saskatchewan bird banders #18, Harry L. Felt of Findlater, bander 007. *Blue Jay* 49:3-6.
- Houston, C. S. 1991b. Saskatchewan bird banders #19, Baynton, Atkinson and Gold. *Blue Jay* 49:59-61.
- Houston, C. S. 2001. Identity of a swallow recovered in Bolivia: a correction. *Blue Jay* 59:101-102.
- Houston, C. S. 2002a. Rural banders in the Saskatoon area. *Blue Jay* 60:35-37.
- Houston, C. S. 2002b. Early Saskatoon city bird banders [#20]. *Blue Jay* 60:79-82.
- Houston, C. S. 2003. Rural banders [#21] in the Yorkton area. *Blue Jay* 61:94-95.
- Houston, C. S. 2005a. Early Saskatchewan bird banders [#23]. *Blue Jay* 63:130-134.
- Houston, C. S. 2005b. Saskatchewan waterfowl banders to 1954. *Blue Jay* 63:175-178.
- Houston, C. S., and W. Anaka. 2003. Birds of Yorkton - Duck Mountain. Saskatchewan Natural History Society, Special Publication no. 24, Regina.
- Houston, C. S., and M. J. Bechard. 1983. Trees and the Red-tailed Hawk in southern Saskatchewan. *Blue Jay* 41:99-109.
- Houston, C. S., and A. Dzubin. 1998. In memoriam: Jerome H. Stoudt, 1910-1996. *Blue Jay* 56:248-250.
- Houston, C. S., and M. I. Houston. 2003. Saskatchewan bird banders #22. J. A. Briggs of Regina. *Blue Jay* 61:138-139.
- Houston, C. S., and M. I. Houston. 2006. Ring-billed Gulls banded in Saskatchewan, 1936-1989. *Blue Jay* 64:131-148.
- Houston, C. S., C. S. Robbins, and M. K. Klimkiewicz. 2008. History of "computerization" of banding records. *North American Bird Bander* 33:57-65.
- Houston, C. S., and J. F. Roy. 2003. In memoriam: F. J. Hartley Fredeen, 1920 - 2003. *Blue Jay* 61:231-232.
- Houston, C. S., and M. G. Street. 1959. Birds of the Saskatchewan River, Carlton to Cumberland. Special Publication no. 2, Saskatchewan Natural History Society, Regina.
- Kennard, J. H. 1975. Longevity records of North American birds. *Bird-Banding* 46:55-73.
- Lincoln, F. C. 1924. Returns from banded birds, 1920 to 1923. U.S. Department of Agriculture Bulletin no. 1268.
- Lincoln, F. C. 1927. Returns from banded birds, 1923 to 1926. U.S. Department of Agriculture Technical Bulletin no. 32.
- Lincoln, F. C. 1933a. Distribution of returns from banded ducks. Fifth paper: Pennsylvania, Saskatchewan, South Carolina, Texas, Utah, and Wisconsin. *Bird-Banding* 4:177-189.
- Lincoln, F. C. 1933b. Bird banding. Pp. 65-87, in *Fifty Years' Progress of American Ornithology, 1883-1933*. American Ornithologists' Union, Lancaster, Pennsylvania.
- Lincoln, F. C. 1936. Recoveries of banded birds of prey. *Bird-Banding* 7:38-45.
- Lincoln, F. C. 1939a. Interesting recoveries of banded birds. Pp. 351-372, in G. Grosvenor and A. Wetmore, eds., *The Books of Birds*, volume 2. National Geographic Society, Washington, D.C.

- Lincoln, F. C. 1939b. The migration of North American birds. Doubleday Doran, New York.
- Rowan, W. 1927. Banding Franklin's Gulls in Alberta. *Wilson Bulletin* 39:44-49.
- Salt, W. R. 1939a. Notes on recoveries of banded Ferruginous Rough-legged Hawks. *Bird-Banding* 10:80-85.
- Salt, W. R. 1939b. The tale of a hawk bander. *Bird-Banding* 10:115-121.
- Sowls, L. K. 1955. Prairie ducks: a study of their behavior, ecology and management. Stackpole, Harrisburg, Pennsylvania, and Wildlife Management Institute, Washington D.C.
- Van Velzen, W. T. 1964. Tabulation of bandings reported each year 1950 to 1953. *Bird Banding Notes* 5:5-18.
- Willers, M. H. [1936]. Adventures in science. Grade III. School Aids and Text Book Publishing Co., Ltd., Regina, Saskatchewan.

APPENDIX 1 - Gazetteer of Saskatchewan place names mentioned. Numbers following each place name are degrees of latitude – degrees of longitude.

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